4. HAZARD-SPECIFIC DISCUSSION

This section of the report discusses the hazards that are present at the INL Site as a result of historic operations. Eight hazard areas at the INL Site are described in the following sections. A hazard area is a portion of the Site that contains hazards that present risks to human health or the environment (e.g., contaminated soil, entombed facilities, contaminated groundwater plumes, or buried waste). This section also provides an overview of the types of cleanup activities and the regulatory processes that govern them. A discussion of various types of risk assessments and the role of risk in selecting cleanup actions and levels also is provided.

4.1 Overview of Hazard Areas

Each section contains general narrative, maps, and conceptual site models that provide additional information about the hazards. The hazards are described as they currently exist (in 2004) and as they are anticipated to exist at the end of the EM cleanup mission. The timeframe for active cleanup is currently anticipated to be 2035, while the timeframe for completion of existing groundwater remediation is 2095. Current mitigation, planned actions, and institutional controls are discussed for each hazard area. In general, the hazard areas correspond to WAGs established in the FFA/CO; however, information on other planned closure activities, such as RCRA closures; VCO activities; and DD&D, also is provided. The eight hazard areas are as follows:

- Section 4.2—Sitewide Soil and Groundwater
- Section 4.3—Test Area North
- Section 4.4—Idaho Nuclear Technology and Engineering Center
- Section 4.5—Radioactive Waste Management Complex
- Section 4.6—Central Facilities Area
- Section 4.7—Waste Reduction Operations Complex/Power Burst Facility and Auxiliary Reactor Area
- Section 4.8—Test Reactor Area
- Section 4.9—Argonne National Laboratory-West.

Conceptual site models provide, in block diagram form, information regarding the hazards, pathways, receptors, and barriers (current and planned) between the hazards and receptors. The conceptual site models, which were prepared during baseline risk assessments and published in approved CERCLA documents, have been updated to reflect current (2004) conditions and modified to show anticipated conditions at the end state. Since the CERCLA baseline risk assessments evaluated risk to hypothetical residential receptors, the conceptual site models in this document include residential receptors. However, there is no current residential use of the INL Site, and no future residential use of contaminated sites is anticipated. The public is protected from hazards by restricted access to the Site. Workers are protected by a combination of administrative procedures, restricted access, and other controls.

4.1.1 Closure Processes

Cleanup activities at the hazard areas may include removal of radioactive waste and other nuclear materials from the INL Site, DD&D of facilities that are no longer needed, RCRA closures of hazardous waste facilities, actions required by the VCO, and CERCLA remedial actions. All closures at the INL are evaluated under either the CERCLA or NEPA regulatory framework.

4.1.1.1 National Environmental Policy Act Closures. NEPA regulations, found in Title 40 *Code of Federal Regulations* Parts 1500–1508, apply to all federal agencies. The NEPA process provides environmental information to public officials and citizens before federal decisions are made and before actions are taken. The NEPA process is intended to help federal agencies make decisions that are based on understanding environmental consequences and take actions that protect, restore, and enhance the environment.

DOE procedures for complying with NEPA are found in "National Environmental Policy Act Implementing Procedures" (10 CFR 1021) and apply to any DOE action affecting the quality of the environment of the U.S. or its territories or possessions. Closures under NEPA may be conducted as categorically excluded activities or may require an Environmental Assessment or Environmental Impact Statement (EIS). A categorical exclusion is a category of actions for which neither an Environmental Assessment nor an EIS is normally required. Categorical exclusions have been defined by DOE in "National Environmental Policy Act Implementing Procedures" (10 CFR 1021) by listing specific categories of activities, which have been determined not to have significant environmental impacts. If it is not clear whether the proposed activity will have a significant environmental impact, an Environmental Assessment is required. The Environmental Assessment evaluates environmental impacts of the proposed activity and briefly considers alternative means of achieving the goal of the activity, including a No Action alternative. The outcome of an Environmental Assessment is either a Finding of No Significant Impact or a decision that preparation of an EIS is required. An EIS is a more extensive evaluation of the environmental impacts of all reasonable alternatives to the proposed action. Both Environmental Assessments and EISs consider risks to human health and the environment. This is done to document the environmental impacts of the various alternatives being considered by DOE. Public involvement is not required for categorically excluded activities but is required for both Environmental Assessments and EISs.

If a structure undergoing DD&D under NEPA is a hazardous waste treatment, storage, or disposal unit subject to permitting requirements under RCRA, which is enforced in Idaho by DEQ through the Idaho Hazardous Waste Management Act (HWMA), then the structure also is required to meet the RCRA closure requirements (see Section 4.1.1.3). Closure requirements under the Clean Air Act, Clean Water Act, or Safe Drinking Water Act also may apply.

4.1.1.2 CERCLA Actions. The CERCLA statute empowers the president to conduct cleanup of hazardous substances that threaten the environment or public health. The president, in turn, has delegated that authority to various federal agencies. While the EPA has received authority over most contamination cleanup, Executive Order 12580 gives DOE the authority and duty to act as the CERCLA lead agency to manage and conduct cleanup of all lands under the management of DOE.

The U.S. Department of Justice has determined, with the concurrence of EPA and DOE, that federal agency actions performed in accordance with CERCLA (enacted in 1980 and amended in 1986) are not subject to the environmental impact analysis process required by NEPA (a statute enacted earlier in 1969). One of the primary reasons for this is that NEPA bars federal agency action until study has been completed, while CERCLA actions are intended to reduce potential harm to the environment posed by past events and, therefore, are presumed to be helpful to the environment. The delay of cleanup actions pending NEPA study or litigation over that study, while the contamination potentially worsens, would be contrary to the intent of Congress in enacting CERCLA.

CERCLA addresses the risk posed by a release of hazardous material to the environment. Released material is not contained and may have moved from the point of release, particularly if the release occurred in the past. The INL was placed on the National Priority List in 1989 because hazardous material had been released to the environment by disposal practices that were legal and acceptable in the past. The CERCLA process involves characterizing the risk posed by the hazardous material and developing actions that will bring the calculated risk to acceptable levels. There are several different types of actions that can be taken, including immediate responses to a current release; time-critical removal actions to allow rapid response before public comments are considered; non-time-critical removal actions, which take place after resolution of public and regulator comments on proposed actions; and remedial actions, which are developed in full coordination with regulators and with full public review and comment resolution.

Most of the CERCLA cleanup activities at the INL have been remedial actions. Remedial actions involve a detailed, formal investigation of the nature and extent of released hazardous substances (through a remedial investigation), an extensive evaluation of alternative methods of countering that contamination (feasibility study), and public review of the proposed action or draft ROD nominated from among those alternatives. The RI/FS is the methodology used to characterize the nature and extent of risks posed by uncontrolled hazardous waste sites and to develop and evaluate remedial options. Because the RI/FS is an analytical process designed to support risk management decision-making for CERCLA sites, the assessment of health and environmental risk plays an essential role. The three basic parts of the RI/FS risk evaluation are (1) baseline risk assessment, (2) refinement of preliminary remediation goals, and (3) remedial alternative risk evaluation.

The feasibility study process involves developing a reasonable range of alternative remediation methods and analyzing these alternatives in detail using nine evaluation criteria. The nine evaluation criteria are as follows:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through the use of treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

The first two criteria (in the list above) are threshold determinations and must be met before a remedy can be selected. The next five criteria are primary balancing criteria. The last two are considered modifying criteria, and risk information does not play a direct role in the analysis of them. Of the five primary balancing criteria, risk information is of particular importance in the analysis of effectiveness and permanence. Analysis of long-term effectiveness and permanence involves an evaluation of the results of a remedial action in terms of residual risk at the site after response objectives have been met. A primary focus of this evaluation is the effectiveness of controls that will be applied to manage risk posed by treatment residuals or any untreated waste that may be left on the site. It also should consider the potential impacts on human health and the environment, should the remedy fail. An evaluation of short-term effectiveness addresses the impacts of the alternative during the construction and implementation phase until remedial response objectives will be met. Under this criterion, alternatives should be evaluated with respect to potential effects on human health and the environment during implementation of the remedial action and length of time until protection is achieved (EPA 1989).

The RI/FS provides decision-makers with a technical evaluation of the threats posed at a site, a characterization of the potential routes of exposure, an assessment of remedial alternatives (including their relative advantages and disadvantages), and an analysis of the tradeoffs in selecting one alternative over another. Because the RI/FS is conducted concurrently, development and analysis of alternatives are interactive processes in which potential alternatives and remediation goals are continually refined as additional information from the remedial investigation becomes available.

CERCLA Section 120 directs that, at facilities owned by federal agencies such as DOE, which have been placed by EPA onto the Superfund National Priorities List, the EPA must concur with the final remedial action. In 1991, DOE, EPA, and State of Idaho agreed to implement the consultation and concurrence provisions of CERCLA Section 120 and the corrective action requirements of RCRA, through the FFA/CO. The FFA/CO establishes a program for DOE to submit drafts of the principal CERCLA remedial action documents to EPA and DEQ on a schedule approved by those agencies, subject to stipulated penalties for missing those deadlines. The FFA/CO also provides an inter-agency process for resolving disputes concerning these draft documents, including the ROD selecting the remedial actions.

CERCLA removal actions are direct actions involving minimal documentation to address a release or threat of a release of hazardous substances into the environment. CERCLA removal actions are not subject to the FFA/CO process but are carried out by DOE in consultation with EPA and DEQ. The use of DOE's removal action authority for performing DD&D projects and the consultation process is the subject of a 1995 joint memorandum issued by DOE and EPA.

The most commonly used type of removal action is the non-time-critical removal action, meaning that at least 6 months of planning time is available before a removal action must begin. For non-time-critical removal actions, an engineering evaluation/cost analysis is prepared. The engineering evaluation/cost analysis includes site characterization information, identification of response objectives, identification of removal response alternatives, and screening and analysis of alternatives. The initial screening of alternatives is based on the answers to four questions:

- Is the option timely with respect to release mitigation and program goals?
- Is the option protective of human health and the environment?
- Is the option technically feasible?
- Are there any major institutional considerations (e.g., access agreements or zoning)?

The remaining alternatives are then analyzed based on four selection criteria: technical feasibility, reasonable cost, institutional considerations, and environmental impacts. The public is given an opportunity to comment on the recommended removal action. The CERCLA lead agency's selected alternative is then documented in an action memorandum. In urgent situations, when action needs to be taken before an engineering evaluation/cost analysis could be prepared and undergo public review, the sole documentation is the action memorandum, which is published at the same time as the start of the time-critical removal action.

4.1.1.3 Resource Conservation and Recovery Act Closures. RCRA closures of hazardous waste treatment, storage, or disposal units will be required at INTEC, TAN, TRA, PBF, and RWMC. The RCRA closures at TRA and PBF are all related to the VCO. The RCRA closures at TAN are scheduled to be complete by the end of 2012. INTEC will require numerous RCRA closures, the last of which (calcine storage bins) will not be complete until after 2035. The Advanced Mixed Waste Treatment Facility at RWMC will require RCRA closure after operations have been completed.

A RCRA closure plan is developed for each closure or is included as part of the RCRA permit. The closure plan specifies closure performance standards, which may include visual criteria, action levels for rinsate and concrete samples, soil cleanup levels, and the methods that will be used to achieve the closure performance standards. The methods for achieving clean closure are established on a case-by-case basis and must be approved by the DEQ. An Idaho HWMA/RCRA unit is considered cleaned and closed if the performance standards identified in "Closure Performance Standard" (40 CFR 264.111; 40 CFR 265.111) are met. If a clean closure cannot be achieved, then the system must be closed in accordance with landfill closure and postclosure care requirements.

For system components (e.g., tanks, lines, or structures), decontamination rinsate data and concrete data are generally compared to action levels to demonstrate clean closure. Risk is considered in establishing site-specific action levels to ensure that they are protective. This is done for each closure by back-calculating risk to workers using a methodology that has been approved by the DEQ. To ensure protectiveness, the allowable risk threshold has been a one-in-one-million probability of developing a cancer as a result of exposure to the contaminants, and the hazard quotient (HQ) has been 1. In addition, risk assessments may be used to establish cleanup levels for environmental media that have been contaminated by a RCRA system (e.g., soils related to tank systems or piping).

The INL VCO requires resolution of a number of self-disclosed potential RCRA compliance issues, most of which are related to tanks and tank systems. Work to resolve these issues under the VCO has been in progress since calendar year 2000. There are still open VCO actions at four INL facilities: INTEC, TAN, TRA, and PBF. The open actions include characterization of tank systems, RCRA closure of those systems where the characterization data confirm that the systems were used to store hazardous waste, and submittal of new site identification forms for nonhazardous tank systems and components that have the potential to release RCRA hazardous constituents to the environment. The open actions at PBF are expected to be complete by the end of 2005. Actions at TAN, TRA, and INTEC will be completed by the end of 2012.

4.1.1.4 Deactivation, Decontamination, and Decommissioning Activities. Currently, approximately 160 facilities at the INL have been identified as excess to DOE's operational needs. The number of excess facilities may change somewhat, as negotiations between EM and NE are still in progress regarding potential future use of some of the buildings. It is estimated that an additional 260 EM facilities will be dispositioned after their current missions are completed. All excess EM facilities will be dispositioned before the end of the EM mission. The initial step in the DD&D of any candidate facility is its inclusion in a facility transfer agreement. The requirements for acceptance and transfer of facilities are defined in "Transition Implementation Guide" (DOE G 430.1-5). These requirements are met through deactivation, whereby systems and equipment are deenergized, drained, isolated, or removed to minimize the surveillance and maintenance costs of maintaining the facility in a safe and environmentally secure condition while awaiting decontamination and decommissioning.

A surveillance and maintenance program must be maintained through completion of DD&D. The purpose of the surveillance and maintenance function is (1) to ensure adequate containment of contamination and (2) to provide surveillance, physical safety, and security controls to maintain the facilities in a safe and stable condition to minimize potential hazards to workers and the public. DD&D often removes contaminated facilities, thus eliminating the need for long-term surveillance and maintenance.

In many DD&D activities, the entire building or structure can be removed and disposed of in an approved disposal facility. In some cases, however, it may not be possible or practical to remove all of the building or structure because of radiation risks to workers, technological constraints, or other reasons. If the proposed closure activity involves leaving radioactive or chemical contamination in place after closure through such activities as grouting or capping, a risk assessment to ensure that the closure will be protective of human health and the environment first would be required. This evaluation would be done through either the CERCLA or NEPA process.

4.1.2 Institutional Controls

CERCLA requires that control be maintained over areas where the risk posed by released hazardous material prevents unrestricted use. EPA has developed policies that provide for the use of institutional controls, including land-use restrictions and access restrictions, as the means of maintaining knowledge and control of residual contamination. EPA Region 10 has issued guidance on how to apply, implement, and document institutional controls. Institutional controls must be maintained until the potential risk from residual contamination is reduced to levels that are considered protective of human health and the environment. A review of conditions at a remediated site and the risk posed by residual contamination must be performed and documented in publicly available reports no less than every 5 years. Institutional controls may be discontinued if contaminant conditions or potential risk levels have been reduced, such as through radioactive decay, to the extent that they are determined to be protective of human health and the environment. The 5-year review is the appropriate time to revise a site designation from No Further Action to No Action and remove institutional controls.

Starting in 2005, the INL will be integrating all CERCLA 5-year reviews into a single Sitewide review that evaluates and documents conditions at every release site with potential risk. Appendix A provides information on the methods and procedures used to maintain and evaluate institutional controls.

4.1.3 Identification of New Sites with Potential Contamination

Previously undiscovered contaminated sites may be found during remediation, DD&D, or construction activities. New potentially hazardous sites that are identified must be reported and identified for remedial action under the FFA/CO or RCRA corrective action requirements, as appropriate. New sites with potential contamination are listed on a New Site Identification Form. This form is used to describe the site, provide information available related to the nature and extent of contamination, and recommend the regulatory path forward. DOE Idaho transmits the completed form to EPA and DEQ for concurrence. Through receipt of EPA and DEQ's concurrence statements, the site is assigned to a particular WAG and OU.

4.1.4 Risk Assessment

4.1.4.1 CERCLA Risk Assessment. A CERCLA baseline risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., No Action). Results of the baseline risk assessment are used to document the magnitude of risk at the site and the primary causes of that risk, to support selection of the No Action alternative where appropriate, to determine whether additional response actions are needed, and to modify preliminary remediation goals. There are four steps in the baseline risk assessment process: data collection and analysis, exposure assessment, toxicity assessment, and risk characterization. Data collection and evaluation involve gathering and analyzing site data relevant to the human health evaluation and identifying substances present at the site that are the focus of the risk assessment process. An exposure assessment estimates the magnitude of actual or potential human exposures, the frequency and duration of the exposures, and the pathways by which humans are potentially exposed. Reasonable maximum estimates of exposure are developed for both current and future land-use assumptions. Conducting an exposure assessment involves analyzing contaminant releases, identifying exposed populations, identifying all potential pathways of exposure, estimating exposure point concentrations for specific pathways based on both environmental monitoring data and predictive chemical modeling results, and estimating contaminant intakes for specific pathways. The toxicity assessment considers types of adverse health effects associated with chemical exposures, the relationship between magnitude of exposure and adverse effects, and related uncertainties. The risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risk.

Typically, CERCLA risk assessments for the INL have been based on both current and future land-use scenarios. The CERCLA human health risk assessments quantified potential carcinogenic (cancer-causing) and noncarcinogenic adverse health effects. Despite an assumption of long-term industrial use at the INL, most of the previous CERCLA baseline risk assessments were conducted using a hypothetical residential scenario, even though residential use was not planned for by DOE and could not happen without DOE permission and cooperation in the difficult process of transferring land with residual contamination (see Section 3.3). In general, the hypothetical residential scenarios assumed continued institutional controls for 100 years, after which a resident was assumed to live next to the contaminated site, consume groundwater from an on-Site well, and engage in subsistence farming. The residential scenarios used for these analyses followed EPA guidelines and assumed that a person would live on the Site 350 days a year for 30 years, beginning 100 years from a baseline date. The baseline dates varied from one ROD to another. Some were based on the 1995 land-use planning decisions; others were based on the year that the RI/FS or ROD was signed. The models assumed that future residents would construct 10-ft basements beneath their homes. Therefore, they could be exposed to contaminants through spreading the excavated materials around the perimeter of the house.

The assessments also examined the potential risk to current and future workers and to ecological receptors. The occupational scenarios modeled nonintrusive industrial use (i.e., disturbances to 4 ft below ground) without restrictions. These conservative scenarios were believed to allow for all impacts of any potential future land use.

Remedial action objectives were developed in accordance with the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300) and CERCLA RI/FS guidance. Remedial action objectives specify contaminants and media of concern, potential exposure pathways, and remediation goals. Remedial action objectives are developed for specific media (i.e., soil, perched water, or groundwater).

To meet the remedial action objectives, remediation goals are established. Remediation goals establish acceptable exposure levels that are protective of human health and the environment. These goals generally are quantitative cleanup levels based on results of a baseline risk assessment and an evaluation of anticipated exposures and risks for selected remedial alternatives.

Noncarcinogenic effects are measured by calculating a hazard index (HI). An HI of 1 represents a threshold level below which no health effects are predicted. If the HI is greater than 1, then some adverse health effects are possible. For known or suspected carcinogens (cancer-causing agents), risk is expressed as the chance of cancer occurring as a result of exposure. The likelihood of any kind of cancer resulting from a site is expressed as a probability (e.g., a one in 10,000 chance). In other words, for every 10,000 people that could be exposed, one extra cancer case is expected to occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than would normally be expected from all other causes. The American Cancer Society reports that between 33 and 50% of Americans are expected to be diagnosed with cancer over their lifetime. In this example, 3,300–5,000 cancers would be expected in a population of 10,000 who did not get the exposure, whereas 3,301–5,001 cancers would be expected in a population that did.

Excess cancer risks estimated below one in one million typically indicate that no further action is appropriate. Risks estimated in the range of one in 10,000 to one in one million indicate that further investigation or remediation may be needed, and risks estimated above one in 10,000 typically indicate that further action is appropriate.

At the INL, a one-in-10,000 cumulative carcinogenic risk or cumulative HI of 1 for noncarcinogenic contaminants, whichever was more restrictive for a given contaminant, was the primary basis for determining remediation goals for release sites. Remediation goals for contaminated soil are based on soil concentrations that satisfy the one-in-10,000 carcinogenic risk goal or noncarcinogenic HI of 1 for current workers, future workers, and future residents. Risk-based remediation goals are used to verify the effectiveness of the selected remedial action and to determine if additional remedial action is necessary before closing a particular release site.

4.1.4.2 National Environmental Policy Act Analysis. The requirements of NEPA are implemented through regulations published in Title 40 *Code of Federal Regulations* Parts 1500–1508. The DOE has developed supplemental implementing regulations that are found in "National Environmental Policy Act Implementing Procedures" (10 CFR 1021). Environmental Assessments must provide sufficient evidence and analysis for determining whether to prepare an EIS or a Finding of No Significant Impact. A Finding of No Significant Impact must present reasons why an action will not have a significant effect on the environment. An EIS must be supported by evidence that agencies have made the necessary environmental analyses. As a result, EISs typically include extensive evaluations of all reasonable alternatives with quantitative descriptions of the environmental impacts of each alternative. Impacts include ecological, aesthetic, historic, cultural, economic, social, or health effects. Effects may be direct, indirect, or cumulative; short term or long term; and beneficial or detrimental. The significance of each impact depends on the following factors:

- The degree to which the proposed action affects public health or safety
- The unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas
- The degree to which the effects on quality of the environment are likely to be controversial
- The degree to which possible effects on the environment are highly uncertain or involve unique or unknown risks
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant, scientific, cultural, or historical resources

- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973

- Whether the action threatens a violation of federal, state, or local laws or environmental requirements.

4.1.4.3 Radioactive Waste Management Risk Assessment. DOE requires a composite analysis and either a performance assessment pursuant to "Radioactive Waste Management" (DOE O 435.1) or risk assessments pursuant to CERCLA for each active and planned low-level radioactive waste disposal facility and for each planned HLW facility closure. The composite analysis is a conservative assessment of the cumulative impacts from active and planned LLW disposal facilities, HLW facility closures, and all other sources of radioactive contamination that could interact with the LLW disposal facility or HLW facility closure to affect the dose to future members of the public. The projected total dose to a hypothetical future member of the public from these sources is compared with the DOE primary dose limit of 100 mrem/year and with the 30-mrem/year dose constraint. If the calculated dose is predicted to exceed the 100-mrem primary annual dose limit within a compliance period of 1,000 years after facility closure, an options analysis must be conducted to identify alternatives for reducing future doses to tolerable levels. If the calculated dose is predicted to exceed the 30-mrem annual dose constraint within the compliance period, an options analysis must be prepared to consider the actions that could be taken to reduce the calculated dose and to consider the costs of those actions. The composite analysis process, including an options analysis and recommendations for further action, supports the DOE decision-making process to ensure that continuing LLW disposal or proposed HLW facility closures will not compromise future radiological protection of the public.

4.1.5 Ecological Risk Assessment

The "National Oil and Hazardous Substances Pollution Contingency Plan," which implements CERCLA, requires that environmental risk evaluations be performed to "assess threats to the environment, especially sensitive habitats and critical habitats of species protected under the Endangered Species Act" (40 CFR 300.430[e][2][I][G]). The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (hereinafter referred to as the OU 10-04 RI/FS) (DOE-ID 2001a) included a comprehensive assessment of risk to ecological receptors at the INL from contamination released to the environment. The OU 10-04 ecological risk assessment was a multiyear effort that included sampling, compilation, and analysis of existing data. Section 17 and associated Appendixes H1–H12 of the OU 10-04 RI/FS provide detail on this effort.

The OU 10-04 ecological risk assessment began in 1995 and was completed in 2001. Results of the OU 10-04 ecological risk assessment summarize the risk to ecological receptors Sitewide. The risk results were used to identify long-term monitoring and stewardship needs.

Each of the WAGs conducted their own area-specific ecological risk assessment as part of their RI/FS. These WAG-specific assessments included evaluations of the contaminated sites in each of the WAGs and identified the sites that posed potential risk to ecological receptors and required either further evaluation or remediation. The OU 10-04 ecological risk assessment integrated results of the WAG-specific ecological risk assessments to determine whether contamination at the WAGs contributes to potential risk to populations and communities on an ecosystemwide basis (over the entire INL). The information sources included assessments of ecologically sensitive areas, ecological sampling on-Site, the breeding bird survey, long-term vegetation transects, radiological biota studies, air dispersion modeling, biological surveys for sensitive species or habitat, and ecological risk assessment summaries for various WAGs.

The OU 10-04 ecological risk assessment concluded that:

- Contamination from past activities is fairly confined to the WAGs based on evidence from ecological sampling and air modeling (e.g., there has been very little dispersion from the contaminated sites)

- CERCLA cleanup activities have removed or will remove and stabilize most contamination within the WAG sites

- Impact is limited to a small percentage of the total INL area

- The presence of large areas of undisturbed vegetation has benefited receptors at the Site.

A 20% change in individuals of a population or species within an exposure unit or community is considered the limit of detection, based on variability of the numbers of each. Results of the evaluation indicate that the overall percentage of the INL ecological habitats impacted by the WAG contamination is less than 2% (not including roads). The ordnance sites, assessed as part of OU 10-04, were evaluated separately because of the possible widespread presence of these sites. The primary contaminants in the ordnance areas were trinitrotoluene (TNT), royal demolition explosive (RDX), and their degradation products. The overall percentage of INL ecological habitats impacted by known areas of TNT and RDX contamination is approximately 3%. Less than 5% of the habitat present on the INL is lost to facility activities. Results indicate that there is minimal risk to the INL plant communities, terrestrial wildlife communities, species of concern, soil fauna, game species, and prey base. Multiple lines of evidence support results of the analysis.

Based on multiple uncertainties, data gaps, and assumptions in the assessment, it was determined that the INL would implement long-term ecological monitoring. The *Record of Decision for Experimental Breeder Reactor-1/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (hereinafter referred to as the OU 10-04 ROD) (DOE-ID 2002a) states, "Monitoring will ensure that expectations regarding the protectiveness of the No Action approach to the INL-wide ERA are met." The *Long-Term Ecological Monitoring Plan for the Idaho National Engineering and Environmental Laboratory* (VanHorn, Fordham, and Haney 2003) was submitted to the agencies in September 2003. Fieldwork was initiated in 2003 to collect baseline samples. Monitoring will focus on detecting possible effects to populations at the Site and providing necessary data to verify modeling and help eliminate uncertainties. The Sitewide ecological monitoring program will provide critical information for continued assessment of this ecosystem. It also will provide the baseline data needed to make informed decisions in the future.

The INL is located in a cool desert ecosystem characterized by shrub-steppe vegetative communities typical of the northern Great Basin and Columbia Plateau region. The surface of the INL is relatively flat with several prominent volcanic buttes and numerous basalt flows that provide important habitat for small and large mammals, reptiles, and some raptors. The shrub-steppe communities are dominated by sagebrush and provide habitat for sagebrush community species, such as sage grouse, pronghorn, and sage sparrows. Rabbitbrush, grasses and forbs, salt desert shrubs, and exotic and weed species comprise other communities. Juniper woodlands occur near the buttes and in the northwest portion of the INL; these woodlands provide important habitat for raptors and large mammals. Limited riparian communities exist along intermittently flowing waters of the Big Lost River and Birch Creek drainages.

The sagebrush ecosystem is currently considered endangered, and many of the associated species are being considered for special protection. As the sagebrush ecosystem and associated species experience more pressure from human activities, the associated importance of protecting areas like the INL will become greater. Since 1980, sage grouse in the western U.S. and Canada have declined as much as 45–82%. Unfortunately, a decline in number of sage grouse also has been observed at the INL. During a 1988 survey, the greatest number of birds observed on-Site was 90 (seen at 50% of the stops on the routes). In 1998, that number shrank to 12 (seen at 7% of the stops on the routes). Sage grouse leks are spread widely throughout the Site.

Several wildlife species are found only or primarily in sagebrush habitats throughout their range. About 100 bird, 70 mammal, and 23 amphibian and reptile species in the Great Basin to some degree rely on sagebrush habitat for shelter and food. Some species, such as the sagebrush lizard, pygmy rabbit, pronghorn, sage sparrow, brewer's sparrow, sage grouse, loggerhead shrike, and sagebrush vole, cannot survive without plenty of high-quality sagebrush and its associated perennial grasses and forbs. Other species depend on sagebrush for a significant portion of their diet. For example, pronghorn depend on sagebrush for nearly 90% of their diet.

A 1999 report prepared by the Western Working Group of the International Bird Conservation Coalition Partners in Flight warns that more than 50% of shrubland and grassland bird species in the Intermountain West show downward population trends. Sage grouse numbers have dipped more than 33% in the last 15 years according to BLM studies. As these species increasingly come to the attention of the concerned public, it will be critical to have information to support decisions made for the assessment.

Investigations determined that more than 100 contaminated sites at different individual WAGs on the INL pose potential risks to ecological receptors. These 100 sites were evaluated in the INL-wide ecological risk assessment. Of those 100 sites, 68 had HQs greater than 10 and required further evaluation. At 28 of the 68 sites, remediation is in progress or has been completed. An additional six sites (the five TNT and RDX contamination sites and the gun range [STF-02], described in Section 4.2 of this document) were evaluated in the OU 10-04 RI/FS (DOE-ID 2001a). NRF sites were included only qualitatively in the INL-wide ecological risk assessment because of the different risk assessment methodology used at NRF. Also, since the RWMC and the INTEC tank farm (OU 3-14) RI/FSs are not complete, information from these areas is not included in the INL-wide ecological risk assessment.

This assessment used a population-level approach for the evaluation of receptors at the INL, with the assumption that much of the modeling and other characterization has been adequate for evaluating this large facility area. This population-level assessment would be invalidated by certain species on the Site obtaining a federal threatened or endangered listing (e.g., sage grouse is currently under consideration). Long-term monitoring will be implemented in anticipation of this. With this understanding, the WAG ecological risk assessment results were evaluated and used to identify receptors and contaminants of concern (COCs) at the Sitewide level to support long-term monitoring.

An ecological conceptual site model from the OU 10-04 ROD (DOE-ID 2002a) is included as Figure 4-1 and Table 4-1. This model is representative of contaminated surface and subsurface soil at each of the hazard areas; therefore, individual ecological conceptual site models are not provided for each of the hazard areas. No ecological conceptual site model for the end state is provided because adequate data are not yet available to accurately predict effects to ecological receptors from low levels of contaminants over long periods of time. For these reasons, ecological monitoring was proposed in the OU 10-04 ecological risk assessment.

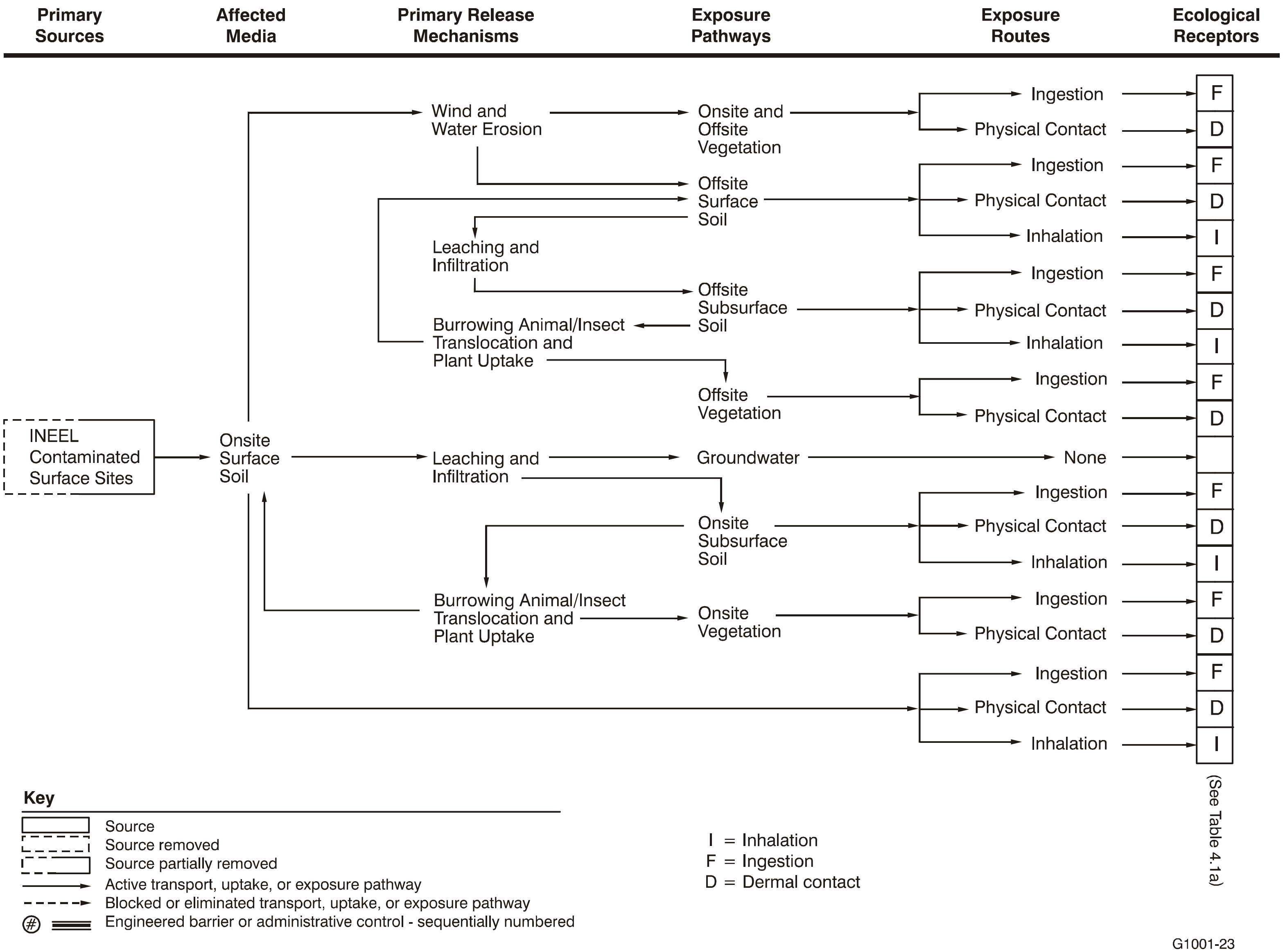


Figure 4-1. Site ecological receptors conceptual site model—current state.

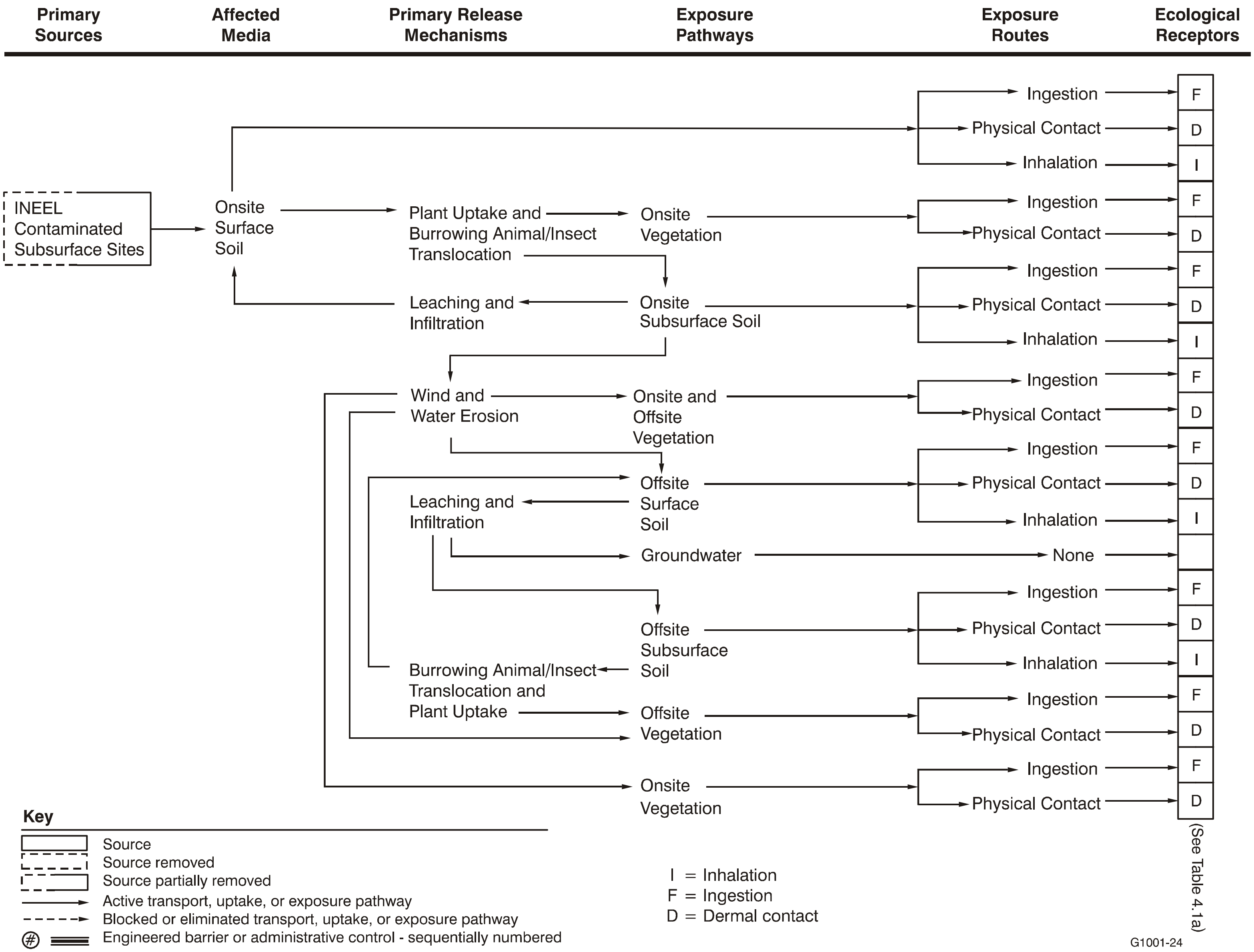


Figure 4-1. (continued).

Table 4-1. Summary of exposure media and ingestion routes for Idaho National Engineering and Environmental Laboratory functional groups.

Receptor	Surface Soil	Subsurface Soil	Vegetation	Sediment	Prey Consumption		
					Invertebrates	Mammals	Birds
Amphibians (A232)	X	X			X		
Great Basin spadefoot toad	X	X			X		
Avian herbivores (AV122)	X						
Mourning dove	X						
Avian (aquatic) herbivores (AV143)			X	X			
Blue-winged teal			X	X			
Avian insectivores (AV222)	X				X		
Sage sparrow	X				X		
Avian carnivores (AV322)						X	
Loggerhead shrike						X	X
Ferruginous hawk						X	
Avian carnivores (AV322A)	X	X			X	X	
Burrowing owl	X	X			X	X	
Avian omnivores (AV422)			X		X	X	X
Black-billed magpie			X		X	X	X
Mammalian herbivores (M122)	X		X				
Mule deer	X		X				
Mammalian herbivores (M122A)	X	X	X				
Pygmy rabbit	X	X	X				
Mammalian insectivores (M210A)	X				X		
Townsend's western big-eared bat	X				X		
Mammalian carnivores (M322)	X					X	
Coyote	X					X	
Mammalian omnivores (M422)	X	X	X		X		
Deer mouse	X	X	X		X		
Reptilian insectivores (R222)	X	X			X		
Sagebrush lizard	X	X			X		
Plants	X	X					

4.2 Sitewide Soil and Groundwater

This section discusses the Sitewide soil area and groundwater. These areas were included in WAG 6 and WAG 10 in the FFA/CO. On a Sitewide basis, groundwater concerns related to the Snake River Plain Aquifer are included in WAG 10. Section 4.2.2 provides a general overview of groundwater contamination at the INL Site. Area-specific groundwater contamination is discussed in more detail in Sections 4.3, 4.4, 4.5, 4.6, and 4.8.

4.2.1 Sitewide Soil

The Sitewide soil area includes all INL land outside the fenced boundaries of the Site's primary facility areas. Remaining occupied or utilized facilities in the Sitewide soil area include the INL firing range (a security force training center), the Experimental Breeder Reactor I historical site, the entrance guard gate facilities, and small structures and utility buildings, such as pumphouses and communications buildings.

The Sitewide soil hazard area includes WAG 6 and WAG 10, designated under the FFA/CO. WAG 6 includes the Experimental Breeder Reactor I and the nearby Boiling-Water Reactor Experiment (BORAX) Area, which includes the sites of five separate experimental reactors that have been decommissioned.

WAG 10 encompasses the INL Site area that falls outside of the other WAGs. Hazards associated with this area include potential unexploded ordnance and associated explosive contaminants remaining from munitions testing activities. The hazard area is extensive, comprised of approximately 217,000 acres. As necessary, WAG 10 also encompasses areas beyond the INL boundaries that may have been impacted by INL activities. Consequently, WAG 10 comprises a large area, much of which is uncontaminated.

The *Declaration of the Record of Decision for Ordnance Interim Action Operable Unit 10-05* (DOE-ID 1992a), which addressed potential unexploded ordnance known or suspected at six sites, was issued in 1992. The *Remedial Investigation/Feasibility Study Report for Operable Units 5-05 and 6-01 (SL-1 and BORAX-1 Burial Grounds)* (Holdren, Filemyr, and Vetter 1995) evaluated risk and remedial action alternatives for the BORAX I burial ground. The selected remedial action for the BORAX I burial ground was presented in the *Record of Decision: Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment–1 Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INL 1996). A comprehensive RI/FS was completed in 2001 and documented in the OU 10-04 RI/FS (DOE-ID 2001a). The OU 10-04 ROD (DOE-ID 2002a) was published in 2002.

4.2.1.1 Current State. The Sitewide soil areas of contamination are shown on Figures 4-2, 4-3, and 4-4.

Eight sites currently require institutional controls to protect against human exposure to contaminants. In addition, institutional controls are maintained at multiple sites with potential unexploded ordnance. Institutional controls include warning signs and control of activities to restrict drilling and excavation. The institutional controls are described in the *Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004b). Each of these sites is briefly summarized below:

- EBR-08—Fuel Oil Tank—The EBR-08 Fuel Oil Tank is the site of an underground storage tank that contained No. 2 diesel heating fuel. Records indicate that the tank was installed in 1952 and was last used in 1988. In 1989, the tank was emptied, and in 1990, the tank and associated piping were removed. Soil under the tank showed evidence of leakage. The primary COC is diesel. All of the diesel-contaminated soil was removed, with the exception of two small areas that could not be accessed because of equipment limitations. A sewer line in the excavation's south side prevented soil removal deeper than 5 ft, and a radiologically contaminated overhead trolley located 2 yd east of the excavation hindered soil removal from an area east of the excavation. The excavation was backfilled with clean soil (DOE-ID 2001a). The ROD selected remedy is institutional controls that restrict the site to industrial land use until discontinued, based on the results of a 5-year review.

- BORAX-01—Leach Pond Associated with BORAX Reactors—This site was used from 1954 to 1964 to collect low-level radioactively contaminated liquid discharges from the BORAX II through V experiments. In 1984, the pond was backfilled with clean soil, graded, and reseeded. In 1992, the associated piping and a small volume of underlying contaminated soil were removed. COCs at the leach pond associated with BORAX II through V reactors are primarily subsurface metals and radionuclides, with the primary COC being cesium-137. The ROD selected action is maintenance of institutional controls to prevent exposure to contaminated soil. Institutional controls will be required for more than 100 years until the radionuclides decay to levels acceptable for unrestricted use.

- BORAX-02—Site of Buried BORAX I Reactor—This BORAX I reactor was used between 1953 and 1954 for dozens of stress tests to explore reactor safety. The reactor was deliberately destroyed in 1954 during a final test designed to determine its inherent safety under extreme conditions. The excursion was more destructive than had been predicted, and the steam explosion scattered fuel plate fragments a distance of 200–300 ft. Immediately following the reactor excursion, a cleanup activity was conducted to physically remove and reprocess the scattered radioactive material. In 1955, the remaining aboveground structures were removed, the reactor was buried in place along with surrounding radionuclide-contaminated soil. The area contaminated from the excursion was covered with 6 in. of gravel. The site was remediated in 1996 in accordance with the *Record of Decision: Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment–1 Burial Grounds (Operable Units 5-05 and 6-01), and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INL 1996). All shrubs, roots, signs, fencing, and other debris were removed from the contaminated area and placed in a layer on top of the original burial ground. Soil, with radionuclide contamination exceeding action levels, was excavated to a depth of 1 ft and placed over the original burial ground. Soil sampling verified that no areas remained with contamination exceeding the action levels. An engineered barrier, consisting of basalt riprap, was constructed over the site. Subsequently, because of the presence of contamination in the soil to the south of the reactor burial ground, additional in situ surveys were performed, and a risk assessment for the residual radiological surface contamination at the site was prepared in 2002. From the results of the assessment, it was concluded that two areas of contamination may exceed risk-based levels. The residual cesium-137 activity at the site will decay to acceptable risk levels for unrestricted use in approximately 300 years. The existing institutional controls and land-use restrictions will be adequately protective until that time. This site was subsequently included in the OU 6-05 and 10-04 ROD (DOE-ID 2002a). The ROD selected remedy is No Further Action with institutional controls to maintain integrity of the containment barrier and to prevent unauthorized intrusion into the capped area.

- BORAX-08—BORAX V Ditch—The BORAX ditch was a radionuclide-contaminated drainage ditch associated with the BORAX II through V reactor experiments. Wastewater was piped from the reactor building to the ditch, where it evaporated or seeped into the ground. The COC at this site is cesium-137. In 1995, a non-time-critical removal action was conducted at the site. Approximately 1,178 yd^3 of radionuclide-contaminated soil were removed from the ditch in 1995 and disposed of in the TRA Warm Waste Pond. The ditch was backfilled, graded flat, and reseeded with native plants. Sampling in the summer of 2000 confirmed that remaining contamination was below the remediation goal of 16.7 pCi/g. The ROD selected remedy is No Further Action with institutional controls. Institutional controls will be maintained until the residual contamination decays to levels acceptable for unrestricted use.

- BORAX-09—Entombed BORAX II through V Reactor Buildings—Reactor experiments were conducted at this site between 1953 and 1964. The site consists of the entombed belowground structures remaining from the Argonne Experimental Facility (AEF-601). Underground items include reactor vessels, water storage pit (now dry), equipment pit, subreactor room, utility pipe trench, and dry storage pit. Concrete shield blocks seal the AEF-601 pits, trenches, and access shaft, all of which have been backfilled with soil. A removal and containment action was conducted at the site from 1996 through 1997. All remaining aboveground structures and systems were removed, and the subfloor levels of the reactor building were entombed. Lead shielding was removed from the BORAX V reactor pit and was sent off-Site for recycling. The mixed waste streams were incinerated at the Waste Experimental Reduction Facility. Belowgrade pits and trenches were backfilled with soil. Radioactively contaminated soil excavated from the head of the BORAX-08 ditch was placed in the reactor building access shaft. The concrete shield blocks were replaced over these areas. The remaining reactor building systems, including two reactor vessels (BORAX II through V) and approximately 780 ft^3 of materials containing asbestos, were buried in the belowgrade concrete structure. The primary COC is cesium-137. The ROD selected remedy is No Further Action and institutional controls to prevent unauthorized intrusion into the entombment structures and buried waste. The area around the site is enclosed with chain-link and barbed-wire fencing and is posted as a radiation area to restrict entry. Institutional controls include warning signs, control of activities (drilling and excavation), and property lease requirements to control future land use.

- OMRE-01—Organic Moderated Reactor Experiment Leach Pond—The leach pond was used for wastewater disposal from the Organic Moderated Reactor Experiment reactor. The reactor operated from 1957 to 1963 and was located about 2 miles east of CFA. In 1979, a portion of the pond's soil was excavated and disposed of at the RWMC. However, the cleanup goal at the time was 1,000 pCi/g, and it is believed that contaminated soil up to this limit was left in place. The pond has been backfilled, and the area has been revegetated with grass. The COCs are radionuclides (primarily cesium-137). The ROD selected remedy is No Further Action and institutional controls to prevent exposure to contaminated soil. This is accomplished through warning signs, control of activities (drilling and excavating), and property lease requirements to control future land use.

- STF-02—Gun Range—The Security Training Facility area, located 2 miles east of CFA, has been used since 1983 for security force practice maneuvers including small arms target practice in a berm. The bullets fragmented and pulverized on impact with the railroad ties, soil, and other bullets in the berm. Bullet debris extends northward approximately 600 ft. An adjacent dry pond also is contaminated with bullet fragments. Approximately 61 tons of lead and 3.4 tons of copper may be present at the site. This area presents unacceptable human health and ecological risks from exposure to lead. The maximum concentration is more than 60 times greater than the EPA's (Region 9) 400-mg/kg preliminary remediation goal for lead. If allowed to migrate, it could result in groundwater contamination exceeding the MCL for lead. The ROD selected remedy is removal, treatment, and disposal of soil. It is estimated that 20,000 yd^3 of soil will require remediation. Institutional controls are used to prevent exposure to contaminated soil. These include visible access restrictions (warning signs) and control of activities (drilling or excavating.). Interim controls will be maintained to protect workers until the selected remedies have been implemented.

- WAG 10 Unexploded Ordnance—Multiple Sites with Potential Unexploded Ordnance—The ordnance areas include three extensive artillery testing and bombing ranges used by the U.S. Navy and U.S. Army Air Corps during World War II. They are the Naval Proving Grounds (also known as the Naval Gun Range), which encompasses 172,495 acres along the INL's central corridor; the Arco High-Altitude Bombing Range, which is a 26,406-acre area to the west; and the Twin Buttes Bombing Range, which includes 9,291 acres along the southeast edge of the Site.

  The term "ordnance" refers to military equipment or apparatus. Explosive ordnance is any munitions, weapon delivery system, or ordnance item that contains explosives, propellants, or chemical agents. Unexploded ordnance refers to these same items after being armed or otherwise prepared for action, launched, placed, fired, released in a way that they cause hazards, or unexploded either through malfunction or design. Unexploded ordnance poses a physical risk to human safety through the danger of explosion when it is handled or contacted, especially by machinery.

  In some areas, ordnance is visibly obvious. In other locations where unexploded ordnance remains from firing activities, projectiles have become imbedded in the ground, and therefore, the ordnance is not as visibly obvious. Unexploded ordnance was cleared and field assessed at several sites during each field season from 1993 through 1997. The term "clearance," when used in discussion of unexploded ordnance, is defined as "the removal of UXO from the surface or subsurface to a pre-established depth." However, the term "cleared" in regard to unexploded ordnance may not mean unrestricted land use. Ground surveys used to detect and clear unexploded ordnance are not 100% effective because of multiple uncertainties in the detection methods. Also, ordnance located up to 10 ft below ground may become exposed to the ground surface through erosion or frost heave. Institutional controls will be maintained at the ordnance areas until the unexploded ordnance hazard is removed or reduced to acceptable levels.

  For ordnance areas, the COC is unexploded ordnance from aerial bombing practice, naval artillery testing, explosive storage-bunker testing, and ordnance disposal. Munitions used for bombing and target practice are likely to be inert although it is suspected that some unexploded ordnance might be present within the ranges. To date, 583 acres have been cleared and approximately 2,420 live items (unexploded ordnance) have been removed and detonated. Multiple sites with potential unexploded ordnance include:

  - Ordnance areas

    – ORD-03: CFA-633, Naval Firing Site and Downrange Area. The Naval Proving Ground, also known as the Naval Gun Range, was used to test-fire 3 to 16-in.-diameter naval ship guns reconditioned at the Naval Ordnance Plant in Pocatello, Idaho. Between 1942 and 1950, approximately 1,650 guns were tested at the Naval Proving Ground. The Naval Proving Ground presents unacceptable risk to human health from unintentional detonation of unexploded ordnance. Twenty-nine ordnance sites were evaluated in the OU 10-04 RI/FS (DOE-ID 2001a), and six sites were determined to have a high probability or the confirmed presence of unexploded ordnance. These sites are the Railcar Explosion Area (ORD-19), the Naval Ordnance Disposal Area (ORD-06), the National Oceanic and Atmospheric Association (NOAA) (ORD-08), the Mass Detonation Area (ORD-13), the Experimental Field Station (ORD-15), and the Land Mine Fuze Burn Area (ORD-24). Although unexploded ordnance has been previously detected and cleared from these sites, the potential for unexploded ordnance still remains.

– ORD-09: Twin Buttes Bombing Range. This area was used by B-17 bombers flying practice missions out of the Army Air Corps base at Pocatello beginning in 1942 and continuing through World War II. The area is approximately 9,291 acres. A 90-acre area was cleared to a maximum depth of 4 ft in 1994. Two detonation pits were encountered, but no unexploded ordnance, bulk explosives, or contaminated soil were found. Items recovered during the removal action included 1,409 expended practice bombs, one sand-filled practice bomb with the black powder spotting charge still installed, two live fuzes, and some partial bomb pieces. During a field assessment in 1996, several empty and crushed practice bombs, an arming vane from an M100 bomb fuze, several expended flare cases, and one unexploded M26 flare bomb were found. Two craters, containing bomb fragments, also were located and investigated. Although unexploded ordnance has been previously detected and cleared from this area, clearance cannot be considered complete for unrestricted land use.

– ORD-01: Arco High-Altitude Bombing Range. This area was used during World War II by the army for aerial bombing practice. This area is over 26,400 acres. It is reported that the primary ordnance at this site had been sand-filled practice bombs with black powder spotting charges. The entire site and adjacent areas were searched on foot by field crews in 1996. The visual assessment observed no signs of craters, detonation tests, surface unexploded ordnance, pieces of explosives, or soil contamination.

- TNT- and RDX-contaminated soil sites

The five TNT- and RDX-contaminated soil sites (i.e., the Field Station, Fire Station, Land Mine Disposal Area, NOAA, and Naval Ordnance Disposal Area) are contaminated by chemical compounds remaining from military ordnance testing involving low-order detonations. TNT and RDX were identified as COCs, based on the human health risk assessment (DOE-ID 2001a). 1,3-dinitrobenzene is a COC for ecological receptors. Contamination consists of larger fragments of TNT and RDX that could pose an explosives hazard and smaller fragments of TNT and RDX that have dissolved into the soil, thereby resulting in unacceptable risk from ingestion and dermal exposure.

– ORD-15: Experimental Field Station. This 5-acre area includes multiple craters within which a variety of explosive tests were conducted. This site is known to contain unexploded ordnance, pieces of explosives, structural debris, and soil contamination. The 1996 field assessment identified remnants of World War I and World War II vintage bombs and widespread heavy concentrations of explosive contaminated soil in two areas. One area was 2 acres in size, and the second area was approximately 0.8 acres. The area was sampled in 1999. Contaminants were detected between 0 and 2 ft below ground; however, the highest detected concentrations were located in the top 0.5 ft of soil. The volume of contaminated soil that must be remediated at this site is estimated at 10 yd^3. The area presents unacceptable human health risks from TNT and potential risk to ecological receptors from exposure to 1,3-dinitrobenzene and TNT in the soil.

– ORD-10: Fire Station II Zone and Range Fire Burn Area. This 33-acre area presents unacceptable human health risks from TNT and potential risk to ecological receptors from exposure to RDX and TNT in the soil. A 10-acre area was cleared to a depth of

2 ft in 1993, and only a few areas of explosive contaminated soil were found. Areas above the TNT action levels were excavated by hand until verification sample results met the cleanup levels of 44 ppm. In 1996, the entire area was assessed. The boundary of soil contamination was mapped. Contaminants were detected between 0 and 2 ft below ground; however, the highest detected concentrations were located in the top 0.5 ft of the surface soil. The volume of contaminated soil that must be remediated at this site is estimated at 150 yd^3.

– ORD-24: Land Mine Fuze Burn Area. This 30-acre area was used by Naval Proving Grounds personnel for disposal of land mine pressure plates, for disposal of aerial bomb packaging materials, and as an area to dispose of land mine fuzes by burning. During the 1996 field assessment, 20 acres were surface cleared, characterized using geophysical methods, and mapped. Several inert items were found and excavated. Soil sampling took place in 1999. Contaminants were detected between 0 and 2 ft, although the highest detected concentrations were in the top 0.5 ft of the soil. The volume of contaminated soil that must be remediated is estimated at 240 yd^3. Some unexploded ordnance was removed from this site in 1996 and 1997, but there is still potential for remaining unexploded ordnance. TNT presents unacceptable risk to both human and ecological receptors.

– ORD-08: National Oceanic and Atmospheric Administration. This 63-acre area was used for a variety of explosive tests and cleanup detonations. The area contains a number of small craters, bomb casings and detonators, and some widely scattered pieces of explosives. The NOAA site has been and is currently being used by NOAA and other governmental agencies for a variety of atmospheric-, geodetic-, and weather–related monitoring and research work. During the 1996 field assessment, the area was searched on foot, and scattered TNT, ranging from small flakes to baseball-size chunks, was located. Soil sampling took place in 1999. Contaminants were detected between 0 and 2 ft, although the highest detected concentrations were in the top 0.5 ft of the soil. The volume of contaminated soil that must be remediated is estimated at 370 yd^3. Although unexploded ordnance was removed in 1993 and in 1997, there is still potential for some unexploded ordnance to remain in the area. TNT was identified as a COC based on human health risk estimates. The exposure pathways of concern are ingestion of soil, groundwater, and homegrown produce. The area presents unacceptable risks to ecological receptors from 1,3-dinitrobenzene, RDX, and TNT in the surface soil.

– ORD-06: Naval Ordnance Disposal Area. This 40-acre area was used as an ordnance and nonradioactive hazardous material disposal area by the U.S. Navy during the 1940s. From about 1967 to 1985, approximately 7,000 lb of reactive materials were burned at the Naval Ordnance Disposal Area. The reactive material portions of the site were closed under RCRA. In 1994, approximately 33 acres were cleared of ordnance and pieces of explosives to a depth of 4 ft. In 1995, an additional 22.6 acres were cleared to a depth of 2 ft. The depth was reduced to 2 ft based on results of the 1994 removal action. Five pits were remediated by excavation in 1995. The area outside the site was surveyed, and multiple types of unexploded ordnance were recovered. Seven live projectiles and one split-open projectile with a live fuze were found. Sampling took place in 1999. Based on the sampling results, only 2 acres of the 138-acre site pose a risk to human health and ecological receptors. Although unexploded ordnance was detected and cleared from this site in 1994, 1995, and 1997, there is still potential for unexploded ordnance to remain in the area. RDX was identified as a COC based on both human and ecological risks. The human exposure pathways of concern are ingestion of groundwater and homegrown produce.

- ORD-21—Juniper Mine—In 1974, the Juniper Mine was used to conduct seismic tests using high explosives. Four of the five explosions detonated during the tests occurred in the Juniper Mine's vertical shaft. The explosive, called IREGEL 376, contained ammonium nitrate as its primary ingredient. One test detonation apparently failed, leaving approximately 16,000 lb of explosive material in the mineshaft at a depth of 95 ft below ground. The mineshaft has been backfilled to the surface. The *Preliminary Scoping Track 2 Summary Report for Operable Unit 10-03 Ordnance* (Sherwood et al. 1998) concluded that, even if the entire mass of residual explosives could be detonated, "a hazard would not be produced above the ground because of the amount of soil in the shaft and the depth of the explosives." The IREGEL 376 vendor stated that the explosive would likely not detonate even if the remaining boosters were detonated. The vendor also stated that it is unlikely the explosive would detonate if struck by a drill bit or excavator. However, the boosters likely would remain capable of detonation indefinitely and could be set off if struck by a drill bit or excavator. The potential for groundwater contamination by nitrate, the only regulated constituent present in IREGEL 376, was evaluated using GWSCREEN. The results, which are summarized in the OU 10-04 RI/FS (DOE-ID 2001a), showed that groundwater concentrations of nitrate in the upper aquifer directly below the mineshaft would be less than the 10-mg/L drinking-water standard. The ROD selected remedy is No Further Action with institutional controls. Institutional controls are warning signs and control of activities (drilling and excavating).

Additional details on contamination and risk levels at these sites are presented in Table 4-2. A Sitewide soil conceptual site model for the current state is provided as Figure 4-5.

4.2.1.2 End State. Maps showing the Sitewide soil areas at the end state are included in Figures 4-6, 4-7, and 4-8. A Sitewide soil conceptual site model for the end state is provided as Figure 4-9.

The ROD requires remediation of the ordnance sites by November 2015. The selected remedy involves visual and geophysical surveys of the areas that have been identified as having a higher risk of containing unexploded ordnance. However, there are limits to the effectiveness of these methodologies. It is cost prohibitive to search every inch of land to a depth of several feet. In addition, because of freeze-thaw cycles, ordnance continues to work its way up to the surface over the years. These limitations, coupled with the large geographic area that potentially may contain unexploded ordnance, make it very difficult to free release areas, as it is not possible to ensure that every potential piece of unexploded ordnance has been identified. Therefore, even if these sites are remediated as scheduled, they will still require permanent institutional controls to protect humans from potential contact with unexploded ordnance.

For the explosives sites, TNT and RDX were identified as COCs based on results of the human health risk assessment. TNT, 1,3-dinitrobenzene, and RDX also were found to pose a risk to ecological receptors. Contamination consists of larger fragments of TNT and RDX that could pose an explosives hazard and TNT and RDX that have dissolved into the soil, resulting in unacceptable risk from ingestion and dermal exposure to human health. Removing the principle-threat waste, TNT and RDX, will be protective because surface exposure will be reduced or eliminated and will reduce the potential groundwater risk. An estimated 800 yd^3 of contaminated soil will be remediated. These sites are to be remediated by 2015. It is anticipated that institutional controls will not be required following remediation.

The STF-02 Gun Range will be remediated by August 2018. It is anticipated that institutional controls will not be required following remediation of the site.

All of the BORAX sites and the OMRE-01 leach pond site are expected to remain under institutional control for radionuclide contamination past 2035 until the cesium-137 decays to acceptable levels.

It also is anticipated that institutional controls may remain in effect for the EBR-08 Fuel Oil Tank site past 2035.

Although no remedial action is required for the Juniper Mine, institutional controls likely will remain in effect past 2035 to prevent intrusion.

4.2.1.3 Risk Assessment. Detailed risk assessment information is presented in the *Remedial Investigation/Feasibility Study Report for Operable Units 5-05 and 6-01 (SL-1 and BORAX-1 Burial Grounds)* (Holdren, Filemyr, and Vetter 1995) and in the OU 10-04 RI/FS (DOE-ID 2001a).

Land-use projections in the INL CFLUP (DOE-ID 1997a) incorporate the assumption that the INL will remain under government management and control for at least the next 100 years. Therefore, the baseline risk assessment simulated a hypothetical residential scenario beginning in 100 years. Most remediation goals are based on soil concentrations equivalent to a risk of one in 10,000 to a hypothetical resident 100 years in the future. Therefore, residual contamination may remain after remediation that precludes immediate unrestricted land use, and institutional controls will be applicable.

To enhance the understanding of Shoshone-Bannock concerns, the INL contracted directly with the Tribes to obtain input for the OU 10-04 RI/FS (DOE-ID 2001a). The Tribes' report is included in Appendix A of the OU 10-04 RI/FS. In the holistic worldview of the Tribes, the land, air, water, plants, animals, and humans are of paramount concern and interconnected. Changes and losses in the landscape are seen as leading to an imbalance in nature that affects all things. The Tribes have specific concerns about contamination of land, water, and air at the INL. These include the maintenance of healthy populations of game and other wildlife; the continued presence of plants and animals important for traditional ritual observations; the protection of human health, particularly the health of tribal members using the INL under the *Agreement-in-Principle between the Shoshone-Bannock Tribes and the United States Department of Energy* (DOE 2002a); the protection of prehistoric and traditional cultural sites and significant landscapes; the use of land in the future; and the sustainable long-term stewardship of the land and its resources.

The tribal analysis completed for OU 10-04 makes it clear that the Tribes consider all contamination at the INL a threat to the traditional subsistence and spiritual ecosystem. The OU 10-04 investigation, therefore, concluded that contaminated sites that pose unacceptable risk to human health or ecological receptors also are unacceptable from the standpoint of tribal concern. The investigation further recognized that some sites would be of concern for Shoshone-Bannock interests even though the CERCLA baseline risk assessment concluded that they do not require cleanup.

4.2.1.3.1 Human Health Risk Assessment—The human health risk assessment quantified the receptor intake of contaminants of potential concern (COPCs) for each WAG 6 and 10 site. The assessment consisted of estimating the magnitude, frequency, and duration of exposure for each exposure route between the environment and human receptors. The baseline risk assessment included an evaluation of human health risks associated with exposure to contaminants through soil ingestion, fugitive dust inhalation, volatile inhalation, external radiation exposure, groundwater ingestion, ingestion of homegrown produce, dermal adsorption of contaminants in groundwater, dermal adsorption of contaminants in soil, and inhalation of water vapors from indoor water use. The occupational scenario was evaluated at the current time and 100 years in the future, and the residential scenario was evaluated starting 100 years in the future. The residential exposure scenario assumed that potential future residents would dig into contaminated sites at WAGs 6 and 10 and spread the contaminated soil around their homes. Child exposures were incorporated into the soil ingestion risk calculations for the residential scenario because studies have shown that children receive proportionately more exposure to contamination through soil ingestion than adults typically receive. The explosive potential of unexploded ordnance was qualitatively evaluated in the human health risk assessment. Future residential groundwater ingestion risk was estimated at peak contaminant concentration or 10,000 years in the future, whichever occurred first.

Exposure scenarios have not been developed to directly evaluate risks to ranchers, hunters, and occasional recreational receptors, because the residential and occupational scenarios bound the risks to receptors that receive infrequent exposures. In other words, as long as the level or risk is acceptable to hypothetical residents and workers, risks to ranchers, hunters, and recreational receptors also will be acceptable.

To ensure that the risk estimates used in the baseline risk assessment were conservative, health-protective assumptions that tend to bound the plausible upper limits of human health risks were used throughout. Therefore, risk estimates calculated by other risk assessment methods would not likely be significantly higher than the estimates presented here. The only contaminant loss mechanism considered in the baseline risk assessment is radioactive decay. Other loss mechanisms, such as leaching and wind erosion, were assumed to be negligible.

The exposure routes with estimated carcinogenic excess risks greater than or equal to one in 10,000 or a noncarcinogenic HI greater than or equal to 1 are ingestion of soil, dermal adsorption of contaminants in soil, ingestion of groundwater, and ingestion of homegrown produce. The associated COCs in soil for the future residential scenario are lead at the STF-02 Gun Range and TNT and RDX at the ordnance areas.

Human health risks from cesium-137 exceed risk-based levels at the BORAX and Organic-Moderated Reactor Experiment sites. Cesium-137 is one of the more common COCs at these sites and at the INL in general. Cesium-137 is found in radioactive waste associated with the operation of nuclear reactors and spent fuel reprocessing plants. It can enter the body when it is inhaled or ingested. Exposure to cesium-137 can result in malignant tumors and shortening of life. The EPA has established an MCL of 4 mrem/year for beta particle and photo radioactivity from radionuclides in drinking water. Cesium-137 is covered under this MCL. The concentration of cesium-137 that is assumed to yield 4 mrem per year is 200 pCi/L. Cesium-137 has a half-life of 30 years and, therefore, often can be remediated within acceptable timeframes through natural decay.

4.2.1.3.2 Ecological Risk Assessment—The goals of the ecological risk assessment were to:

- Define contamination extent with respect to ecological receptors for each site
- Determine the actual or potential effects of contaminants on wildlife, habitats, or special environments
- Identify sites and COPCs to be further evaluated in the Sitewide environmental risk assessment (see Section 4.1)
- Supply input to remedial-action decisions.

To quantify receptor intakes, contaminant sources were identified, exposed ecological receptors were identified and characterized, and potential exposure pathways were evaluated. Surface and subsurface soil was the only media considered. Groundwater was eliminated as a medium of concern in the ecological risk assessment because it is not accessible to ecological receptors. Surface water was eliminated because no significant permanent surface water features are present in WAGs 6 and 10. There are a number of transient features, including the Big Lost River, the playas, and the spreading areas that provide habitat during some years, but this is not consistently available for use.

Ecological risk is expressed as an HQ. The primary rationale for maintaining contaminants as COPCs was an HQ above 10 for nonradionuclides and an HQ above 1 for radionuclides at more than one INL WAG. Contaminants with HQs below target levels were removed from the OU 10-04 ecological risk assessment COPC list, provided the contaminant was not highly toxic, persistent, or possibly bioaccumulative in the terrestrial environment. Many radionuclides were retained on the list because of their common presence in the environment, public concern, and the presence of large amounts in buried waste at the INL Site.

All radionuclides were eliminated in the contaminant screening process. The risk characterization generated a quantitative assessment of potential risk for nonradiological contaminants. If the approximated dose of a given contaminant did not exceed its toxicity reference value (i.e., if the contaminant had an HQ of less than 1 for nonradiological constituents), adverse effects to ecological receptors are not expected.

Ecological risks were identified for six of the OU 10-04 sites. They are the Experimental Field Station, Fire Station II and Range Fire Burn Area, Land Mine and Fuze Burn Area, NOAA, Naval Ordnance Disposal Area, and STF-02 Gun Range. These sites all contained COPCs with HQs greater than 1. These sites also present unacceptable risks to human health.

Ecological risk assessment results concluded that secondary explosives at many sites represented the greatest risks to ecological receptors. If these items and contaminated soil were left in place, the primary risks would be ingestion of RDX, TNT, and other explosive degradation products. It is uncertain whether these materials would be mistakenly ingested as food by mammalian and avian receptors, but potential remains for this exposure pathway, especially during preening and grooming activities. Small mammals and ground-feeding birds were identified as the most likely receptors to be exposed. Risks associated with accidental detonation of unexploded ordnance are expected to be minimal. It is unlikely that an animal could strike an ordnance with enough force to cause a detonation.

Table 4-2. Contaminant concentrations and risk levels for Sitewide soil areas under institutional control.

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (100 years)	Future Residential Risk (100 years)	Ecological Risk (HQ)[a]	Remediation Status	ICs for >100 years	Basis for ICs and Comments
EBR-08 Fuel Oil Tank	Diesel heating fuel	N/A	Not available.	N/A[b]	N/A[b]	N/A	N/A[c]	No further action required	No	Risk to the current residential resident is 7 in 1,000,000 from exposure to total petroleum hydrocarbon in the soil.
	Benzene	N/A	≤1.94 mg/kg.	N/A	N/A	N/A	N/A	No further action required		Risk to the current residential resident is 7 in 1,000,000 from exposure to total petroleum hydrocarbon in the soil.
	Total petroleum hydrocarbon diesel	N/A	≤44,300 mg/kg.	N/A	N/A	N/A	N/A	No further action required		Risk to the current residential resident is 7 in 1,000,000 from exposure to total petroleum hydrocarbon in the soil.
	Xylene	N/A	63.2 mg/kg.	N/A	N/A	N/A	N/A	No further action required		Risk to the current residential resident is 7 in 1,000,000 from exposure to total petroleum hydrocarbon in the soil.
BORAX-01 Leach Pond	Cesium-137	N/A	<175 pCi/g (in 1982).	2 in 10,000	6 in 100,000	4 in 100,000	4 to 8 for strontium-90	No further action required	Yes	Unacceptable risk to current occupational receptors. Some elevated risk to future occupational and residential receptors. ICs include annual assessment and maintenance of signs.
BORAX-02 Buried BORAX 1 Reactor Site	Cesium-137	16.7 pCi/g (future residential)	An area of elevated cesium-137 concentrations remains outside the cap; however, a risk analysis demonstrated that the average risk for the site was acceptable. Contaminated soil above remediation goal was consolidated under the engineered barrier.	3 in 10^{8}	7 in 10^{9}	7 in 10^{9}	1 to 8 for strontium-90	No further action required	Yes	ICs are required to prevent intrusion. ICs include annual assessment and maintenance of signs.
BORAX-08 BORAX V Ditch	Cesium-137	16.7 pCi/g (future residential)	Maximum = 8.1 pCi/g Mean = 1.3 pCi/g.	5 in 10^{8}	5 in 10^{9}	2 in 10^{8}	All <1	No further action required	No	ICs are required until residual cesium-137 decays to levels acceptable for unrestricted use. ICs include annual assessment and maintenance of signs.

Table 4-2. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (100 years)	Future Residential Risk (100 years)	Ecological Risk (HQ)[a]	Remediation Status	ICs for >100 years	Basis for ICs and Comments
BORAX-09 Entombed BORAX II through V Reactor Buildings	Cesium-137	N/A	Not available.[d]	1 in 10^8	1 in 10^9	2 in 10^{10} [e]	All <1	No further action required	Yes	ICs are required to prevent intrusion. ICs include annual assessment and maintenance of signs.
OMRE-01 Leach Pond	Cesium-137	N/A (cleanup goal in 1979 action was 1,000 pCi/g)	<240 pCi/g.	1 in 10,000	2 in 100,000	9 in 100,000	All <1	No further action required	Yes	Unacceptable risk to current occupational receptors. Some elevated risk to future occupational and residential receptors. ICs include annual assessment and maintenance of signs.
STF-02 Gun Range	Lead	400 mg/kg[f]	3.05–24,400 mg/kg.	No	No	Yes	2 (ferruginous hawk) to 2,000 (sage sparrow)	Pending	No	Lead concentrations exceed EPA's preliminary remediation goal for lead for unrestricted land use.
ORD-01 Arco High-Altitude Bombing Range	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared	Yes	There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-03 CFA-633 Naval Firing Site and Downrange Area	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared	Yes	There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-06 Naval Ordnance Disposal Area	RDX	4.4 mg/kg (future residential and ecological)[h]	0.22–328 mg/kg.	4 in 100,000	4 in 100,000	2 in 100 HQ = 100 (all pathways)	3 (Townsend's western big-eared bat) to 4,000 (pygmy rabbit)	Partially cleared	Yes	RDX poses a risk to human and ecological receptors. Human exposure pathways of concern are groundwater and homegrown produce.
	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared		There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.

Table 4-2. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (100 years)	Future Residential Risk (100 years)	Ecological Risk (HQ)[a]	Remediation Status	ICs for >100 years	Basis for ICs and Comments
ORD-08 National Oceanic and Atmospheric Administration	TNT	16 mg/kg (future residential and ecological)	0.20–17,014 mg/kg.	2 in 10,000 HI <1 (all pathways)	2 in 10,000 HI <1 (all pathways)	1 in 1,000 HI = 40 (all pathways)	4 (mule deer) to 500 (pygmy rabbit)	Pending	Yes	TNT poses risk to human and ecological receptors. Human exposure pathways of concern are ingestion of soil, groundwater, and homegrown produce.
	1,3-DNB	6.1 mg/kg (ecological)	0.22–27 mg/kg.	N/A	N/A	N/A	1 (mule deer) to 200 (pygmy rabbit)	Pending		1,3-DNB presents risk to ecological receptors only.
	RDX	4.4 mg/kg (future residential and ecological)[h]	0.22–53 mg/kg.	N/A	N/A	N/A	1 (mule deer) to 20 (pygmy rabbit)	Pending		RDX at this site presents risk to ecological receptors only.
	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared		There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-09 Twin Buttes Bombing Range	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared	Yes	There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-10 Fire Station II Zone and Range Fire Burn Area	TNT	16 mg/kg (future residential and ecological)	0.20–130 mg/kg.	2 in 100,000 H = 0.2 (all pathways)	2 in 100,000 HI = 0.2 (all pathways)	1 in 10,000 (all pathways) HI = 10	9 (deer mouse) 20 (pygmy rabbit)	Pending	Yes	TNT poses risk to human and ecological receptors.
	RDX	4.4 mg/kg (future residential and ecological)[h]	0.23–3.7 mg/kg.	N/A	N/A	N/A	2 (mule deer) 40 (pygmy rabbit)	Pending		RDX presents potential risk to ecological receptors only.

Table 4-2. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (100 years)	Future Residential Risk (100 years)	Ecological Risk (HQ)[a]	Remediation Status	ICs for >100 years	Basis for ICs and Comments
ORD-13 Mass Detonation Area	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared	Yes	There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-15 Experimental Field Station	TNT	16 mg/kg (future residential and ecological)	0.28–1,100 mg/kg.	6 in 100,000 HQ = 1 (all pathways)	6 in 100,000 HQ = 1 (all pathways)	9 in 100,000 HQ = 10 (all pathways)	200 (deer mouse) 300 (pygmy rabbit)	Pending	Yes	TNT poses risk to human and ecological receptors.
	1,3-DNB	6.1 mg/kg (ecological)	<14 mg/kg.	N/A	N/A	N/A	30 (deer mouse) 80 (pygmy rabbit)	Pending		1,3-DNB poses risk to ecological receptors only.
	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared		There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-19 Rail Car Explosion Area	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared	Yes	There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.
ORD-21 Juniper Mine	Explosive material buried 95 ft below ground	N/A	N/A.	No	No	No	None	No further action required	Yes	Land-use controls are maintained to prevent intrusion into buried explosive material. ICs include annual assessment and maintenance of signs.
ORD-24 Land Mine Fuze Burn Area	TNT	16 mg/kg (future residential and ecological)	0.26–79,000 mg/kg.	4 in 1,000 HQ = 70 (all pathways)	4 in 1,000 HQ = 70 (all pathways)	6 in 1,000 HI = 700 (all pathways)	900 (deer mouse) 10,000 (pygmy rabbit)	Pending	Yes	TNT poses risk to human and ecological receptors. Human exposure pathways of concern are ingestion of soil, groundwater, and homegrown produce.
	Unexploded ordnance	N/A	N/A.	N/A[g]	N/A[g]	N/A[g]	None	Partially cleared		There is a potential for unexploded ordnance to remain in the area. Unexploded ordnance poses a physical risk to human safety through danger of explosion when it is handled or contacted, especially by machinery.

Table 4-2. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (100 years)	Future Residential Risk (100 years)	Ecological Risk (HQ)[a]	Remediation Status	ICs for >100 years	Basis for ICs and Comments

Sources of Information:

Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I (DOE-ID 2004b)

OU 10-04 ROD (DOE-ID 2002a)

OU 10-04 RI/FS (DOE-ID 2001a)

a. Ecological risk is expressed as an HQ. The primary rationale for maintaining contaminants as contaminants of potential concern was an HQ above 10 for nonradionuclides and an HQ above 1 for radionuclides at more than one INL waste area group. Contaminants with HQs below the target levels were removed from the Operable Unit 10-04 ecological risk assessment contaminants of potential concern list, provided the contaminant was not highly toxic or persistent or possibly bioaccumulative in the terrestrial environment. Many radionuclides were retained on the list because of their common presence in the environment, public concern, and the presence of large amounts in buried waste at the INL Site.

b. The EBR-1 facility is a National Historic Landmark and is not continuously occupied. Therefore, the occupational exposure scenario is not applicable.

c. The contamination is more than 10 ft below ground, therefore, no pathway to ecological receptors exists.

d. Detailed information on source terms that were used to calculate risk is provided in the Operable Unit 10-04 remedial investigation/feasibility study.

e. Two scenarios were used to evaluate risk to the 100-year future resident. The first assumed that the future resident would build a house directly on top of the old reactor building foundation and floor, with the house being centered directly over the BORAX II through IV reactor pit. The second would be a future resident building a home with a 10-ft-deep basement at the BORAX V end of the old reactor building foundation.

f. EPA's preliminary remediation goal for lead for unrestricted land use.

g. Human health risks cannot be calculated for unexploded ordnance in the same way as for chemical contamination. Instead, the need for cleanup is based on an assessment of physical danger. Unexploded ordnance poses a physical risk to human safety through the possibility of explosion when handled or contacted, especially by machinery. Though unexploded ordnance encounters are relatively common, there has never been an accidental detonation at the INL caused by casual human contact.

h. EPA, 2000, *Ecological Soil Screening Level Guidance, Draft, Eco-SSL-Ecological Soil Screening Levels*, U.S. Environmental Protection Agency, July 2000.

BORAX = Boiling-Water Reactor Experiment
EPA = U.S. Environmental Protection Agency
HI = hazard index
HQ = hazard quotient
INL = Idaho National Laboratory
N/A = not applicable
RDX = royal demolition explosive
TNT = trinitrotoluene

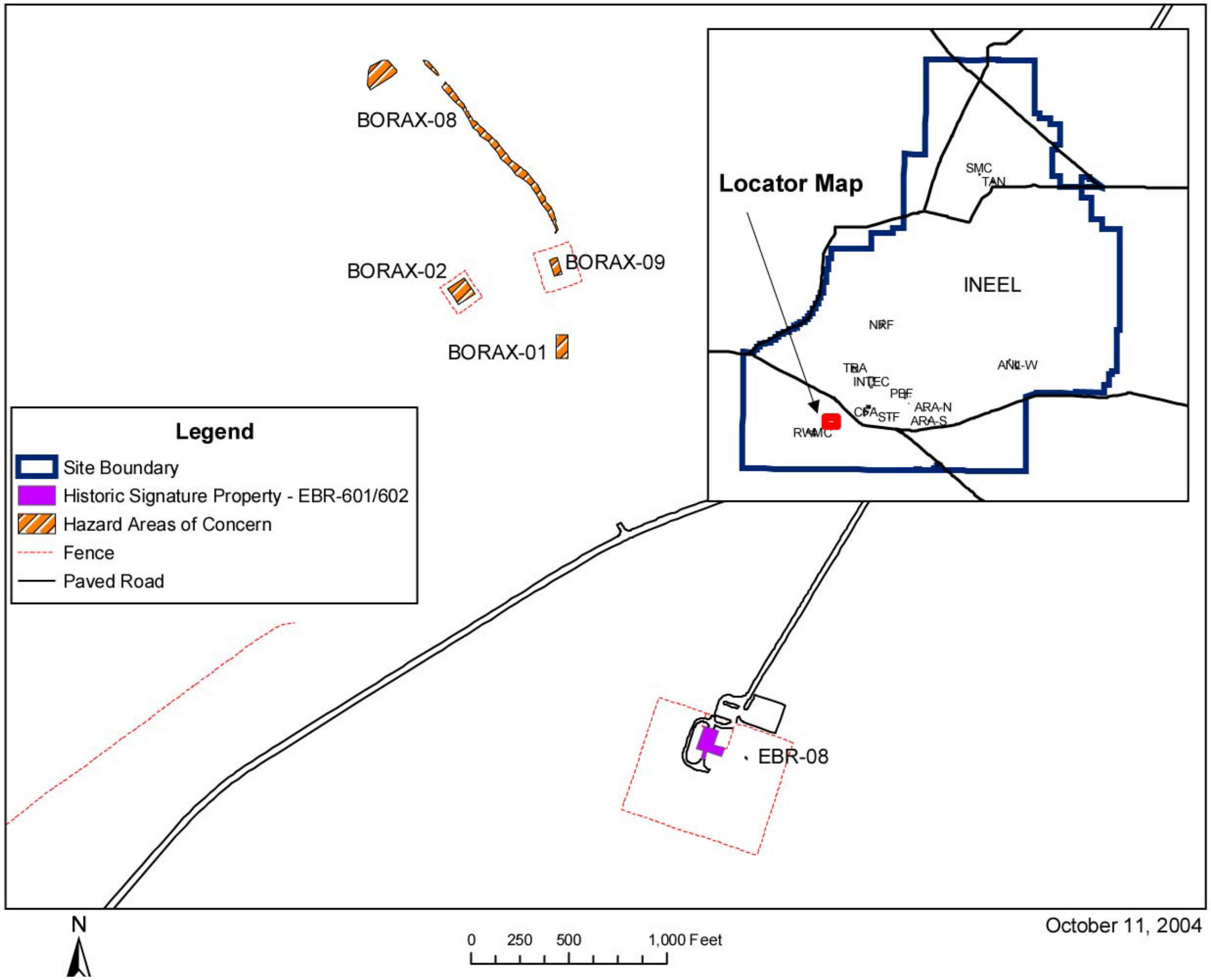


Figure 4-2. Sitewide soil Boiling-Water Reactor Experiment and Experimental Breeder Reactor sites map—current state.

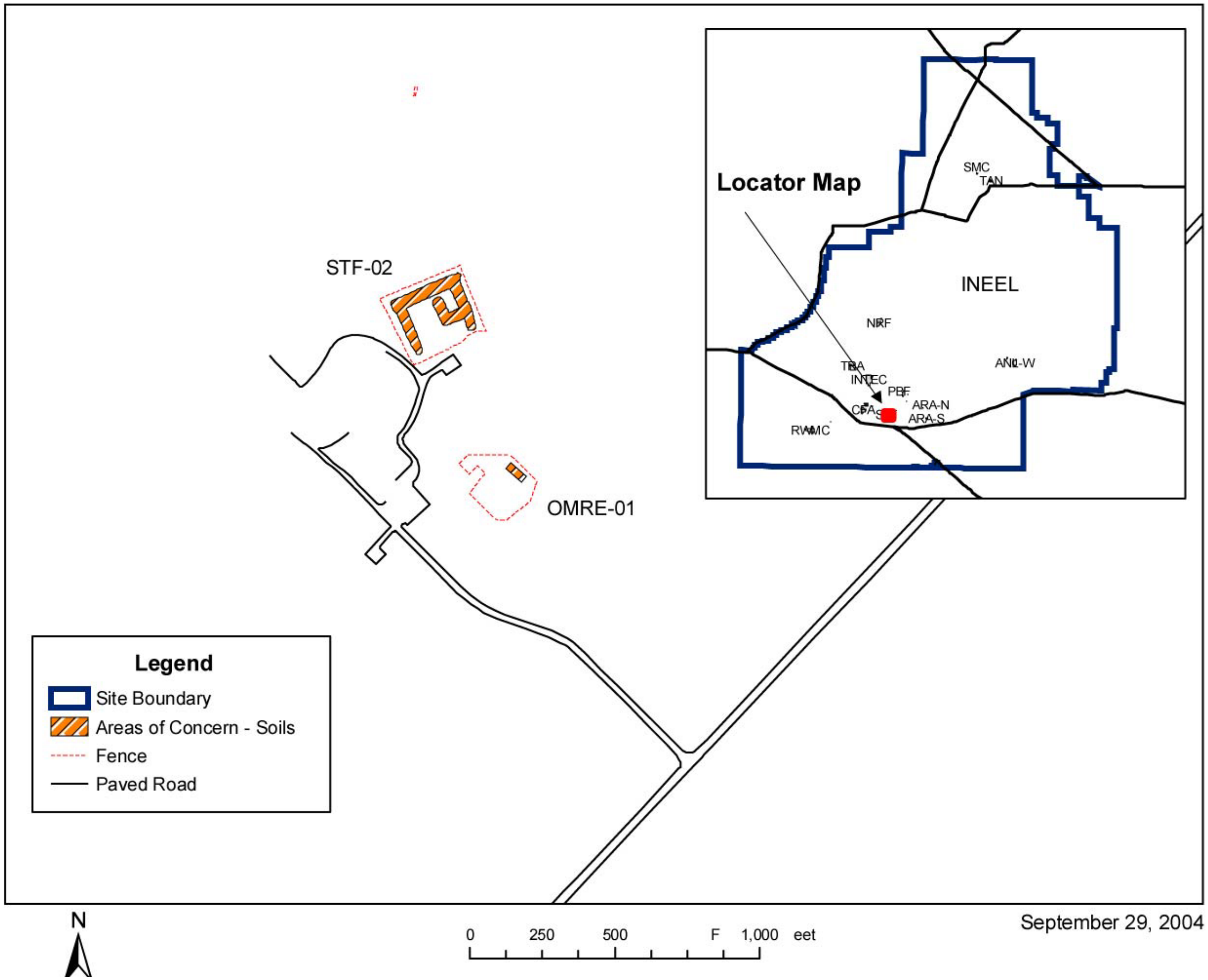


Figure 4-3. Sitewide soil Security Training Facility and Organic-Moderated Reactor Experiment sites map—current state.

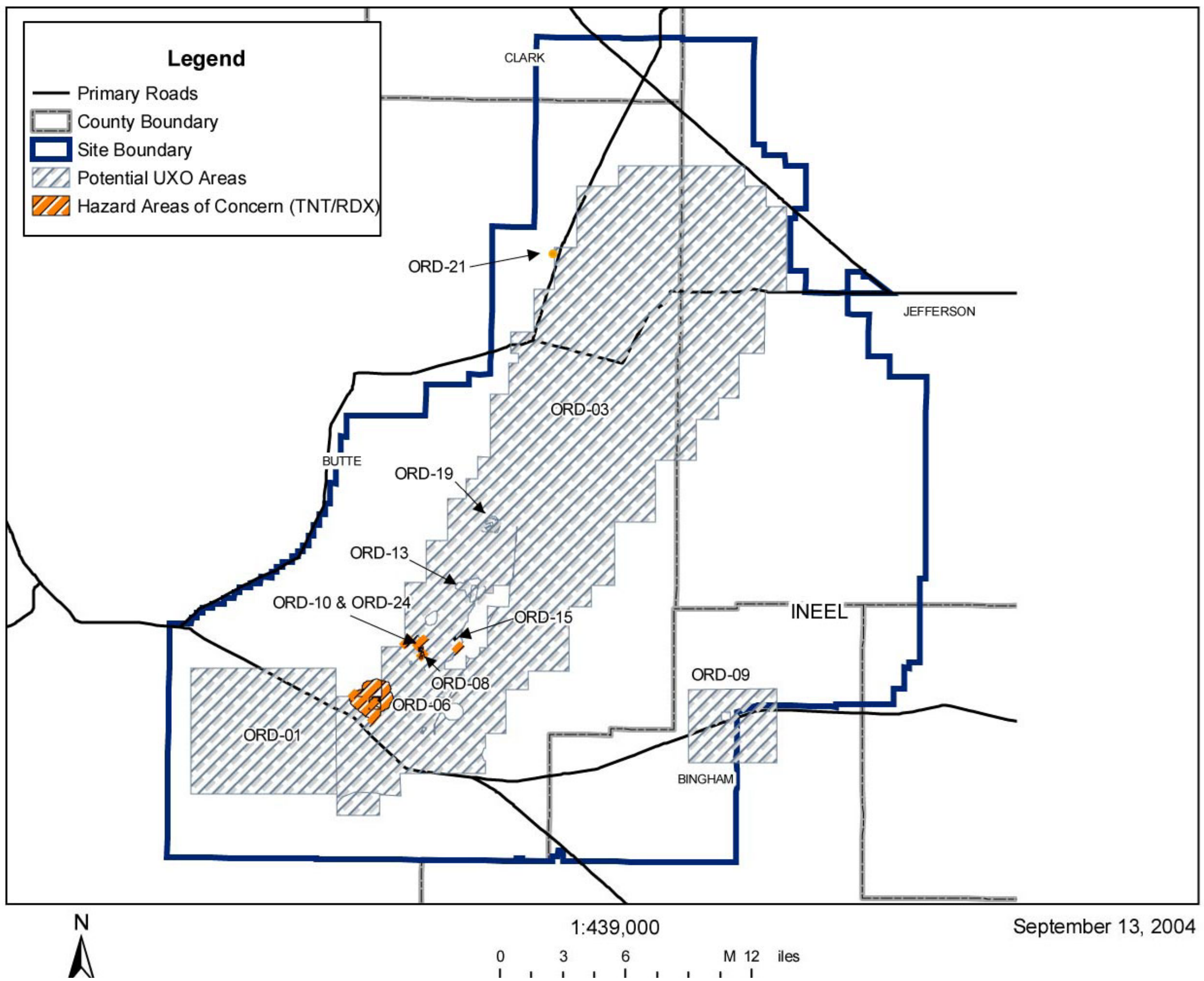


Figure 4-4. Sitewide soil ordnance hazard areas map—current state.

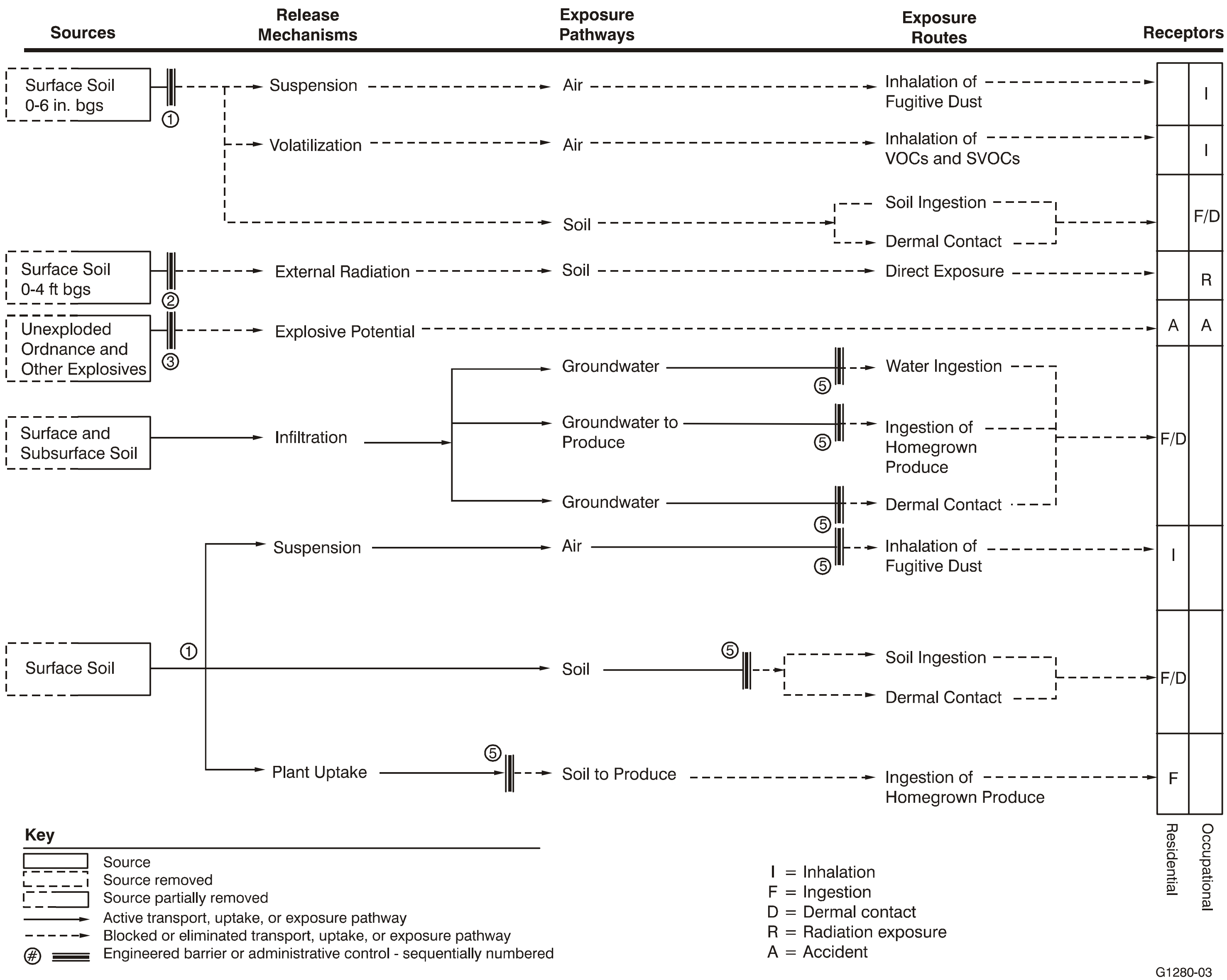
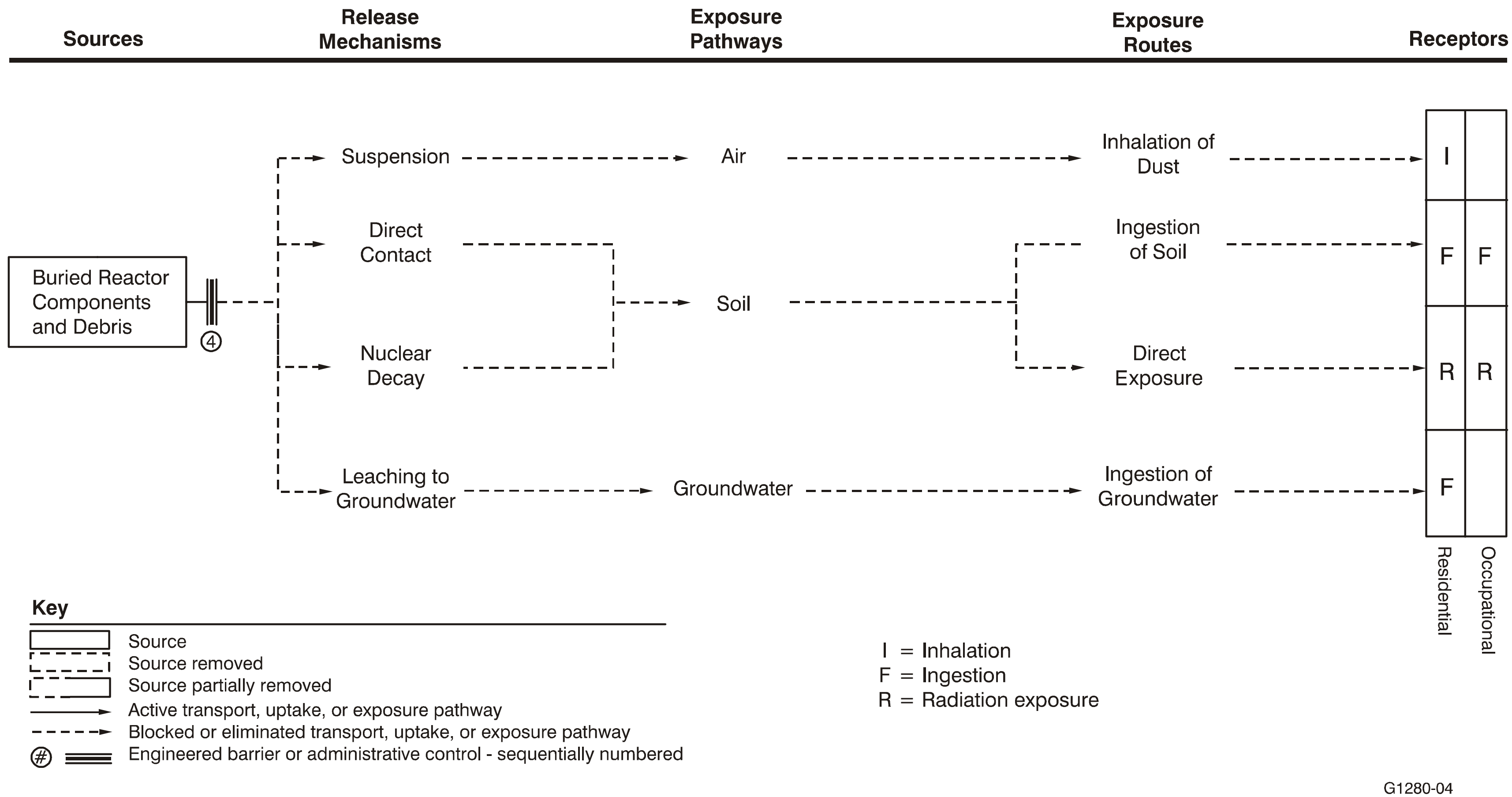


Figure 4-5. Sitewide soil conceptual site model—current state.



SVOC = semivolatile organic compound

Figure 4-5. (continued).

Narrative for Figure 4-5 Sitewide Soil Conceptual Site Model—Current State

In the Sitewide soil hazard area, no further actions are needed at Sites EBR-08, BORAX-01, BORAX-02, BORAX-08, and BORAX-09. Depth to groundwater in the BORAX area is 640 ft below ground, and migration of contaminants from the BORAX sites is unlikely because of the nature of contamination, the high evaporation rates at the INL, and the depth to groundwater. No further action is planned for these sites or for OMRE-01 and ORD-21. Remedial actions are still required for the STF-02 Gun Range, which has lead and copper contamination; for the ordnance areas, which contain potential unexploded ordnance; and for the TNT and RDX areas with soil contaminated with explosive chemicals. Institutional controls are in place for all of the sites listed above, so there are no open pathways to human receptors.

<u>Actions and Barriers</u>:

The steps taken to mitigate or remove these hazards are as follows:

1. The only sites with remaining surface contamination are the STF-02 Gun Range and TNT and RDX areas. The surface contaminated soil was removed from EBR-08 and BORAX-08. The contaminated soil at BORAX-01, BORAX-02, BORAX-09, and OMRE-01 was covered with clean soil or an engineered barrier.

   Institutional controls are in place to protect workers and the public. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities.

2. Radionuclide-contaminated soil was excavated and removed from BORAX-08. Although some radionuclide-contaminated soil remains at BORAX-01, BORAX-02, and BORAX-09, it has been covered with clean soil or an engineered barrier to protect receptors from external radiation exposure. Radionuclide contamination at OMRE-01 was determined to be below risk-based levels, so no further action is needed.

   Workers are protected from direct exposure to radionuclide contamination through institutional controls. These controls include posting of signs at contaminated sites, radiological training, and work control processes used to identify hazards and mitigation measures for planned work activities.

3. Some ordnance has been removed at some of the higher-risk ordnance sites. However, the majority of the areas with potential unexploded ordnance have not been surveyed or cleaned up. In addition, the Juniper Mine site (ORD-21) contains buried explosive material. The explosives are buried 95 ft below ground, and the mineshaft has been backfilled with soil, so human intrusion is extremely unlikely.

   Institutional controls are in place to protect workers and the public from inadvertent contact with explosive materials. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities. The Juniper Mine has institutional controls in place, including visible access restrictions (warning signs).

4. Buried reactor components are found at BORAX-02 and BORAX-09. The BORAX-02 reactor and contaminated soil were buried in place, and an engineered barrier was constructed over the site. The BORAX-09 reactor was entombed with concrete and buried under clean soil. Migration of this contamination to groundwater is very unlikely because all contamination is contained within the concrete subfloor of the original reactor building, and concrete shield blocks are in place above the contamination. Long-term institutional controls, including visible access restrictions (warning signs) and work control processes to restrict drilling and excavation, are in place while the cesium-137 decays to acceptable risk-based levels.

5. The entire INL Site has restricted access to prevent intrusion by the public. Visible access restrictions (warning signs) are in place at sites with institutional controls.

<u>Failure Analysis</u>:

Failure analysis for each of the selected remedial options is provided in the OU 10-04 RI/FS (DOE-ID 2001a). Measures to maintain the barriers are discussed in the *Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004b).

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity inconsistent with the specific institutional controls for a site (e.g., unauthorized well drilling or intrusion into engineered covers) or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a) (e.g., change in land use from industrial to residential). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.

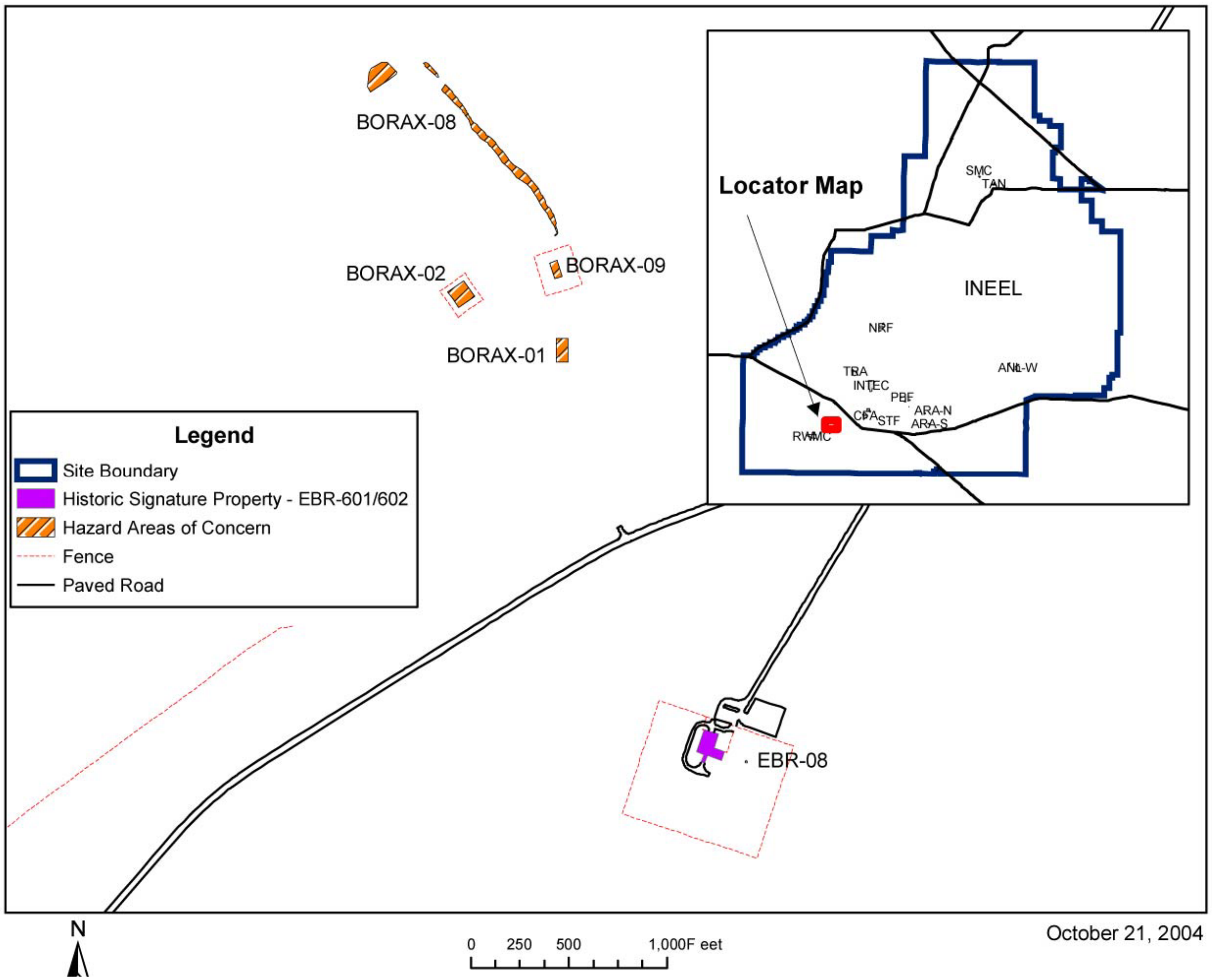


Figure 4-6. Sitewide soil Boiling-Water Reactor Experiment and Experimental Breeder Reactor sites map—end state.

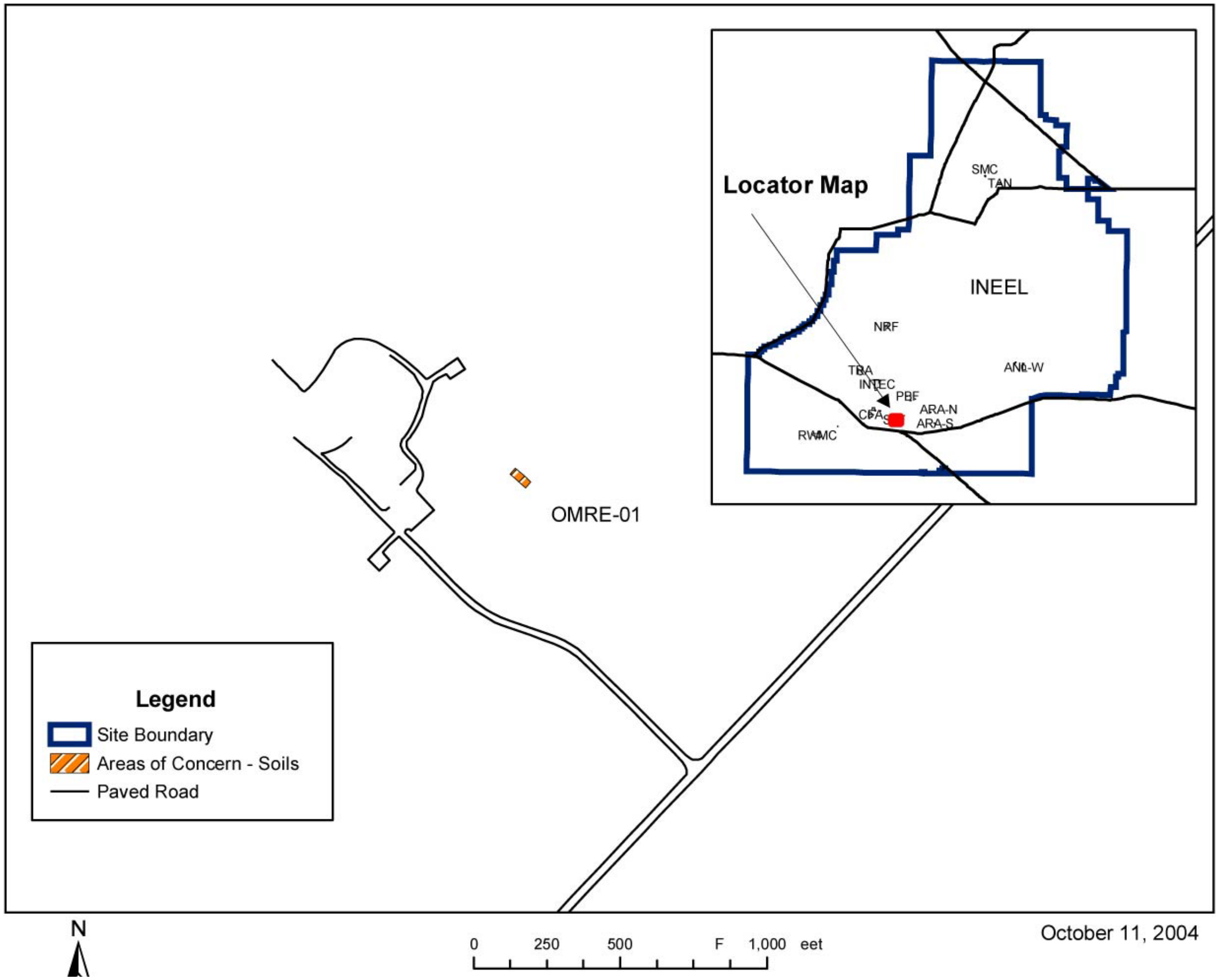


Figure 4-7. Sitewide soil Security Training Facility and Organic-Moderated Reactor Experiment sites map—end state.

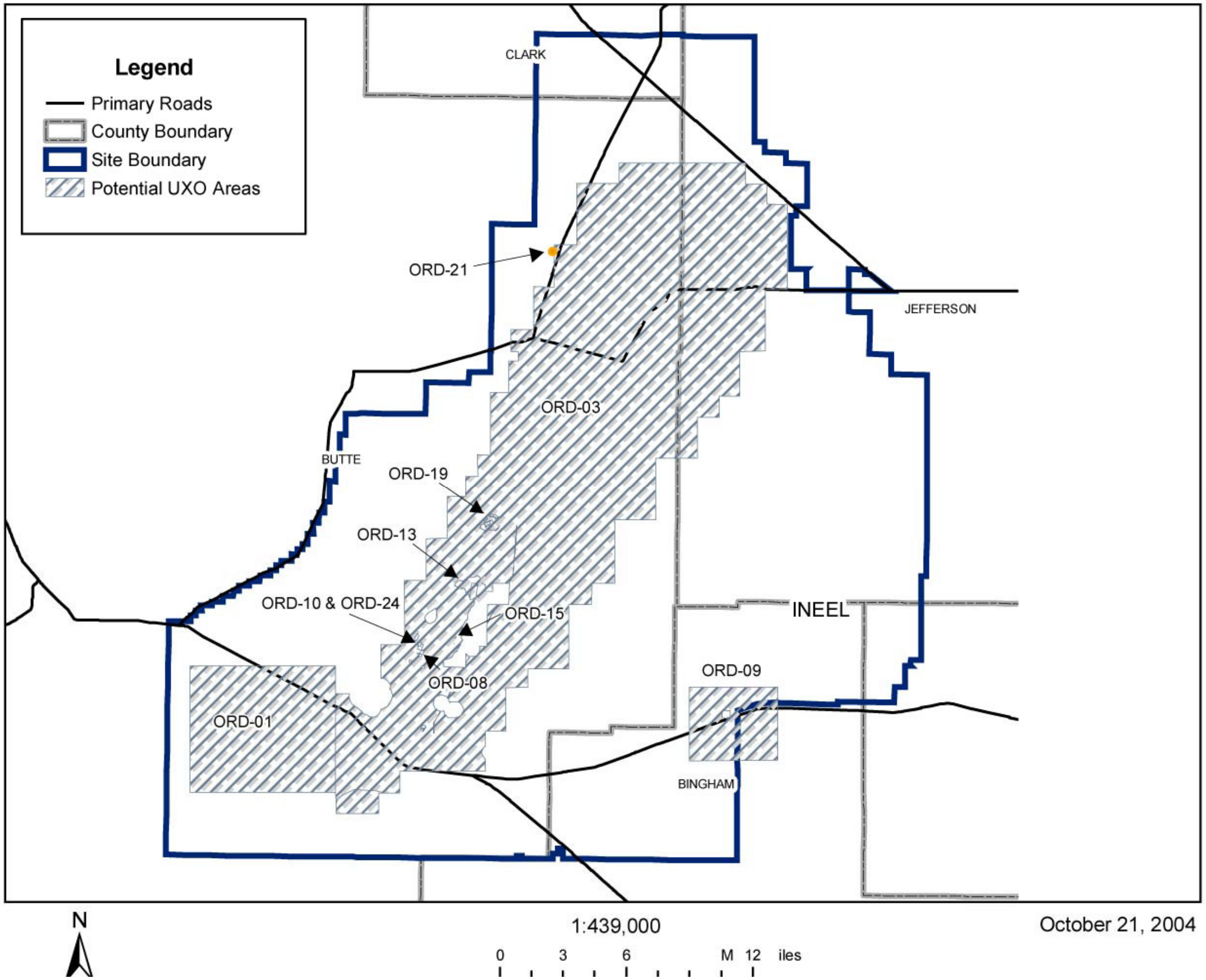


Figure 4-8. Sitewide soil ordnance hazard areas map—end state.

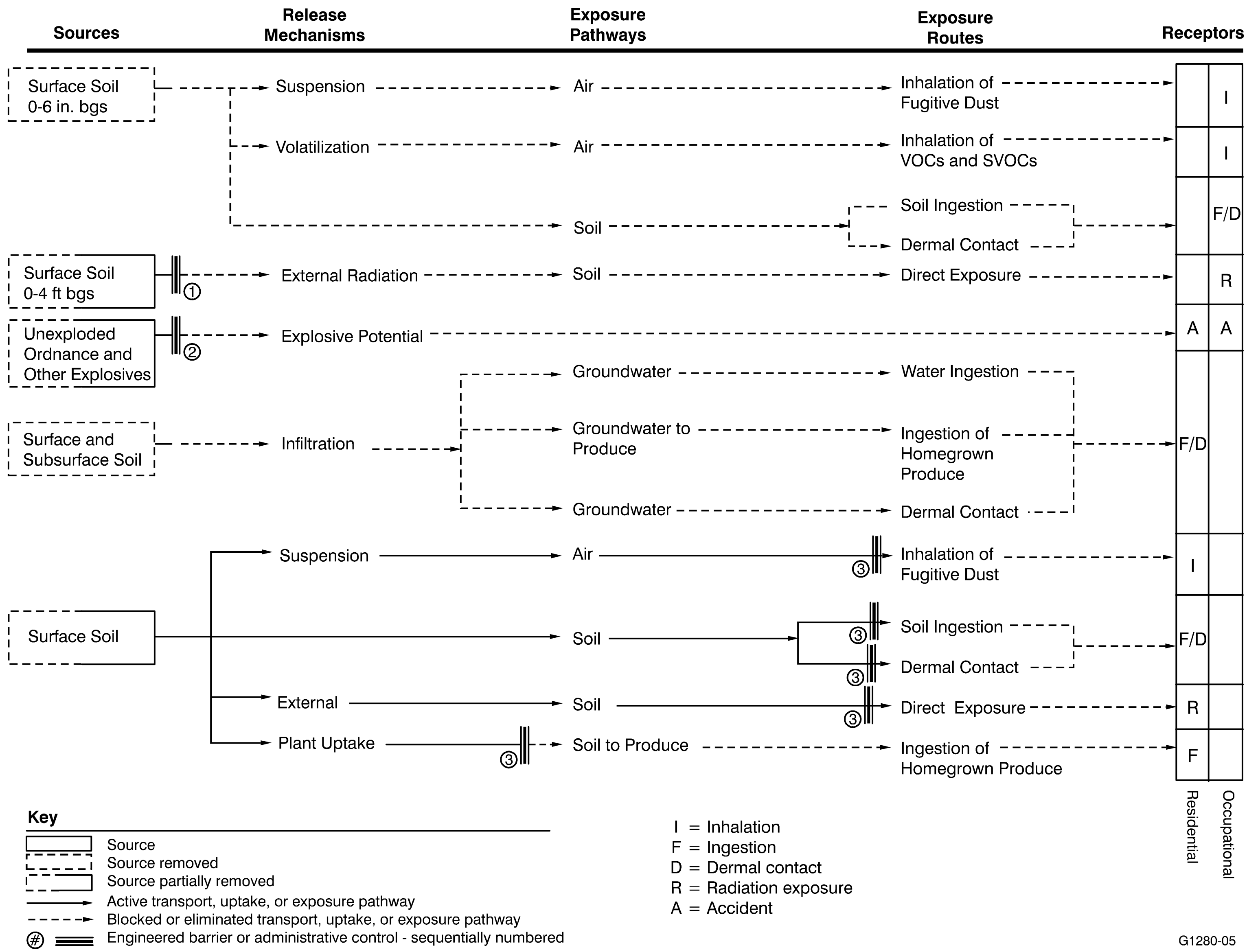
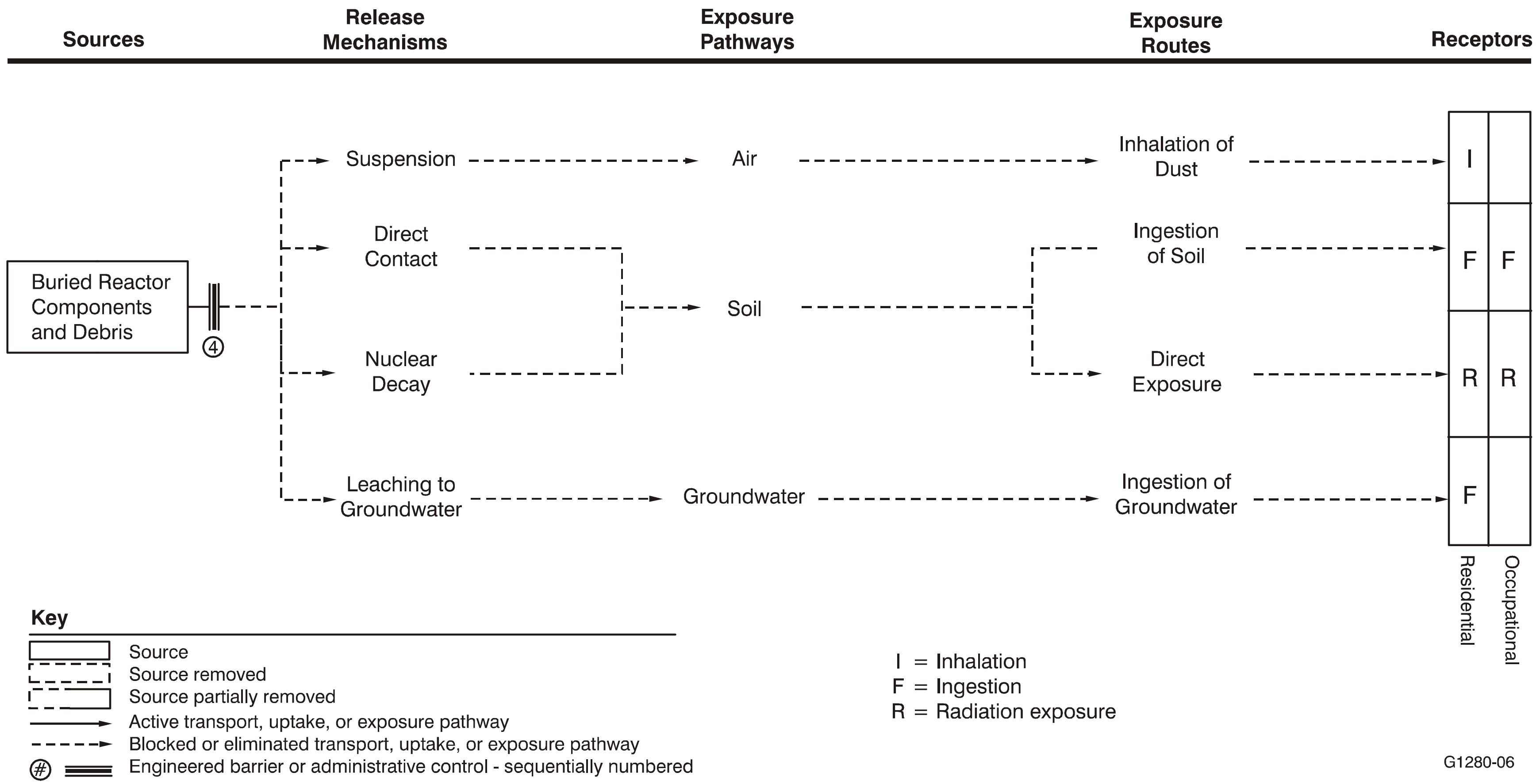


Figure 4-9. Sitewide soil conceptual site model—end state.



SVOC = semivolatile organic compound

Figure 4-9. (continued).

Narrative for Figure 4-9 Sitewide Soil Conceptual Site Model—End State

Remedial actions will be completed for the STF-02 Gun Range, which has lead contamination. The selected remedy is excavation of contaminated soil and disposal in the INL CERCLA Disposal Facility (ICDF). Lead that can be recovered from the soil will be recycled off-Site or treated before disposal. No institutional controls are expected to be required at the gun range after cleanup. The ordnance areas will require long-term institutional controls. Institutional controls also will be required at the ORD-21 Juniper Mine. The BORAX sites and OMRE-01 leach pond site will require long-term institutional controls until cesium-137 decays to acceptable levels. It also is possible that EBR-08 Fuel Oil Tank site may require institutional controls past 2035 because of residual diesel contamination in subsurface soil.

<u>Actions and Barriers</u>:

The steps taken to mitigate or remove these hazards are as follows:

1. Some radionuclide-contaminated soil will remain at BORAX-01, BORAX-02, BORAX-09, and OMRE-01. All these areas have been covered with clean soil or engineered barriers to prevent radiation exposure. Although no further action is needed, long-term institutional controls will be required at these sites. Workers will continue to be protected from direct exposure to radionuclide contamination through institutional controls. These controls include posting of signs at contaminated sites, radiological training, and work control processes used to identify hazards and mitigation measures for planned work activities. If the DOE mission should end at some future point, property transfer requirements with deed restrictions would be required.

2. Selected removal of ordnance will have taken place at some of the higher-risk ordnance sites. In addition, cleanup of the TNT and RDX sites to appropriate and approved levels will have been completed. The ORD-21 Juniper Mine site will still contain buried potentially explosive material 95 ft below ground.

   Institutional controls will be required at the ordnance areas and the Juniper Mine to protect workers and the public from inadvertent contact with explosive materials. The INL Site will continue to have restricted access to prevent intrusion by the public. Workers will be protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities. The Juniper Mine will continue to have institutional controls in place, including visible access restrictions (warning signs) and work control processes to prevent drilling and excavation. If the DOE mission should end at some future point, property transfer requirements with deed restrictions would be required.

3. Some radionuclide-contaminated soil will remain at BORAX-01, BORAX-02, BORAX-09, and OMRE-01. Although no further action is needed, long-term institutional controls will be required to protect the public from exposure at these sites. The entire INL Site has restricted access and use to prevent intrusion by the public. Visible access restrictions (warning signs) are in place at sites with institutional controls. In the event the DOE mission should end in the future, deed restrictions will be required to prevent future residential use of these areas.

4. Buried reactor components are found at BORAX-02 and BORAX-09. The BORAX-02 reactor and contaminated soil were buried in place, and an engineered barrier was constructed over the site. The BORAX-09 reactor was entombed with concrete and buried under clean soil. Long-term institutional controls, including visible access restrictions (warning signs) and work control processes to restrict drilling and excavation, will be required while the cesium-137 decays to acceptable risk-based levels. In the event the DOE mission should end in the future, deed restrictions will be required to prevent future residential use of these areas.

Failure Analysis:

Failure analysis for each of the selected remedial options is provided in the OU 10-04 RI/FS (DOE-ID 2001a). Measures to maintain the barriers are discussed in the *Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004b).

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity inconsistent with the specific institutional controls for a site (e.g., unauthorized well drilling or intrusion into engineered covers) or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a) (e.g., change in land use from industrial to residential). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.

4.2.2 Groundwater

Past and current activities at the INL, including reactor research, nuclear fuel reprocessing, nuclear waste storage, and other nuclear research, represent real or perceived risks to the eastern Snake River Plain Aquifer. Quantification of these risks requires improved understanding of local (e.g., waste disposal practices) and regional (groundwater recharge and mixing) processes.

The Snake River Plain Aquifer is nearly 200 miles long and 60 miles wide. The aquifer is composed of two systems. The shallow, or effective, portion of the aquifer occurs from the water table (200–900 ft below land surface) to a depth of 980–1640 ft below land surface. Fast-moving, (5–34.5 ft/day), cold (48–60ºF) calcium- and magnesium-rich water characterizes this part of the aquifer. The deeper portion of the aquifer is characterized by slower moving (0.02–0.3 ft/day), warm (greater than 60ºF) water. Recharge to the aquifer is primarily from the drainage of highlands north of the plain. Water in the aquifer flows generally southwestward and is discharged to the Snake River through a series of springs near Hagerman, Idaho, approximately 160 miles southwest of the INL. The INL covers about 9% of the aquifer. Depth to water varies from approximately 200 ft in the northeast corner of the INL to over 900 ft in the southeast corner. Water-table contours for the aquifer below the INL are depicted in Figure 4-10. The regional flow is to the south-southwest, though locally the direction of groundwater flow is affected by recharge from rivers, surface water spreading areas, groundwater pumping, and heterogeneity in the aquifer. Across the southern INL, the average gradient of the water table is approximately 5 ft/mile.

In areas where significant surface water percolates into the subsurface, lenses of water perch on low-permeability layers above the regional aquifer. These zones of perched water are associated with sources of surface water, such as the Big Lost River and unlined percolation ponds at facilities. They are of no economic importance but, where contaminated, can act as a continuing source of contamination with the potential of driving contaminants to the aquifer.

4.2.2.1 Groundwater Monitoring. Groundwater at the INL is monitored extensively for radiological and nonradiological constituents. On-Site groundwater is monitored to:

- Satisfy specific CERCLA-related remedial action objectives or regulatory requirements
- Determine the nature and extent of groundwater contamination during CERCLA RI/FS activities
- Evaluate general groundwater conditions and contaminant fate and transport on a regional and subregional scale.

More than 400 wells are used to monitor groundwater for contamination at and around the INL. Most of these wells are located in the immediate vicinity of contaminant sources. Some wells are located upgradient of the INL in the vicinity of Mud Lake and measure the water quality in the aquifer before it flows under the INL. Other wells are located downgradient of the INL as far west as Thousand Springs. Monitoring is performed by federal and state agencies along with DOE contractors. The wells are monitored as often as quarterly, ranging to annually, depending on the data needs of specific programs.

Some contaminated groundwater at the INL is in perched water zones or is in transit through the vadose zone. These areas also are monitored.

Groundwater contamination is measured by collecting water samples from selected monitoring wells. The presence and concentration of contaminants in a groundwater sample are determined in an analytical laboratory. Knowledge of aquifer and contaminant characteristics, coupled with computer modeling of groundwater and contaminant movement, helps to predict how contaminants might spread in the aquifer. The *Idaho National Engineering and Environmental Laboratory Environmental Monitoring Plan* (DOE-ID 2004c) summarizes groundwater monitoring performed both on-Site and off-Site.

The United States Geological Survey (USGS) conducts special studies of groundwater of the Eastern Snake River Plain. One special USGS investigation of particular interest has been the annual sampling effort in the area between the southern boundary of the INL and the Twin Falls/Hagerman area, known as the Magic Valley Study. This study was prompted by public concern that radiochemical and chemical constituents generated by INL facilities could migrate through the Snake River Plain Aquifer to the Snake River in the Twin Falls/Hagerman area.

The public has expressed concern about effects that waste disposal practices at the INL may have on the water quality of the Snake River Plain Aquifer. In the late 1980s, DOE requested that USGS conduct studies to respond to the public's concern and to gain a greater understanding of the radiochemical and chemical quality of water in the aquifer. Between 1989 and 2002, an annual sampling effort in the area between the southern boundary of the INL and Hagerman was conducted by USGS and the Idaho Department of Water Resources in cooperation with DOE. The initial round of sampling involved analyzing water samples collected from 55 sites during August and September 1989. Subsequent sampling has involved analyzing water samples annually from about one-third of the 55 sites, so that all 55 sites are sampled every three years. In 2002, for budgetary reasons, the total number of sampling sites was reduced to 46. Because water quality results from eliminated sites generally were similar to those of nearby sites remaining in the sampling program, the impact on overall water quality information is expected to be negligible.

In 2002, samples were collected from eight irrigation wells, three domestic wells, one stock well, one dairy well, one commercial well, one observation well, and two springs. None of the reported radiochemical or chemical constituents exceeded the established MCLs for drinking water. In fact, levels for tritium were consistent with background concentrations of tritium in groundwater in Idaho. The most recent results of this study are summarized in *Radiochemical and Chemical Constituents in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman Area, Idaho, 2002* (USGS 2004). The Idaho Department of Water Resources will conduct future sampling in this area.

4.2.2.2 Groundwater Modeling. Because aquifers are difficult to observe directly through the use of wells and other information, scientists use sophisticated numerical models to test their understanding of the aquifer system. Models are constructed using information from well logs, monitoring data, and other available information to form a framework or grid that represents the entire aquifer domain. The domain is defined as the area of interest and ranges from small facility scale to large regional scale. The models predict future contaminant concentrations in the aquifer, pathways by which contaminants might reach humans, and risks to human health. The models also are used to evaluate various cleanup options.

Scientists have an array of numerical models and data analysis tools to apply to models. If a model predicts that groundwater contamination will exceed acceptable values, it can be used to examine cleanup options and to guide additional data collection efforts.

Models require assumptions about how water and contaminants travel in different rocks and soil, factors that are highly variable. As a result, models may have a high degree of uncertainty and require validation through monitoring data.

4.2.2.3 Aquifer Cleanup at the Idaho National Laboratory. Aquifer cleanup at the INL is driven by potential risk to people who might drink groundwater drawn from the aquifer beneath or downgradient of the INL. For the next 100 years, it is assumed that institutional controls, such as controlled access and land-use restrictions, will protect INL personnel and prevent potential future residents from exposure to contaminated water. During this 100-year period, if monitoring and modeling indicate that natural processes will result in aquifer contaminants diminishing to concentrations that meet drinking water standards, no cleanup action is required other than continued monitoring, environmental review, and institutional controls. However, if aquifer contaminants are predicted to persist at concentrations exceeding drinking water standards beyond 100 years, cleanup actions must be undertaken.

Because of ongoing cleanup work, contaminated groundwater has not spread, nor is it projected to spread, in concentrations sufficient to pose a risk to water users outside the INL boundaries. However, at several locations within the INL boundaries, contaminated groundwater exceeds MCLs at this time and would pose a risk if it were to be consumed as the only source of drinking water.

Although wastewater is still disposed of at the INL using sewage drainfields and disposal ponds, older disposal ponds have been replaced with lined evaporation ponds, and wastewater currently discharged to the environment does not carry contaminants in concentrations that pose a risk. Wastewater disposal is closely monitored by the DOE, EPA, and DEQ to ensure that new aquifer contamination does not occur.

WAG 10 includes regional aquifer concerns related to the INL that cannot be addressed on a WAG-specific basis. OU 10-08 was added to WAG 10 to address Sitewide groundwater issues and potential new sites. Information from the OU 10-08 investigation will be used to develop a baseline for groundwater information for institutional control and monitoring at the INL.

4.2.2.4 Regulatory Framework for Groundwater Protection. The State of Idaho has established a three-tiered aquifer use designation system. Aquifers are designated general-resource aquifers, sensitive-resource aquifers, and other-resource aquifers. The Snake River Plain Aquifer is designated a general-resource aquifer.

The DEQ has established groundwater quality standards in “Ground Water Quality Rule” (IDAPA 58.01.11). Section 200 states that the groundwater quality standards “apply to all ground water of the state and shall not be exceeded unless otherwise allowed in this rule.” The primary constituent standards are based on protection of human health and, with very few exceptions, are identical to EPA MCLs for drinking water. Section 44.05 of the “Ground Water Quality Rule” allows standards to be relaxed when “remediation {is} conducted under the Department’s oversight.” Relief from the MCL-based standards also may be obtained by petitioning the department to have groundwater characterized as an other-resource aquifer or by proving that background levels for specific constituents exceed MCLs.

The “National Oil and Hazardous Substances Pollution Contingency Plan” (40 CFR 300), which is the implementing regulation for CERCLA, requires that groundwater restoration occur within a reasonable timeframe. The National Contingency Plan groundwater protection strategy requires that both current and potential future use of the groundwater be considered in remedy selection and that groundwater resources be protected and restored if necessary and practicable. Remedial action alternatives must meet two threshold criteria: (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements. The drinking water standards promulgated pursuant to the Safe Drinking Water Act are considered applicable or relevant and appropriate requirements.

The agencies have determined that a reasonable timeframe for aquifer restoration to drinking water standards should not exceed 100 years. The 100-year timeframe is derived from DEQ concurrence with DOE that INL will remain under federal government control for a minimum of 100 years. However, DEQ has historically interpreted the statement in the INL CFLUP (DOE-ID 1997a), “the implementation of this management and control becomes increasingly uncertain over this time period,” as a justification to assume loss of federal control after 100 years, with possible residential use of contaminated sites thereafter. Even if the DOE mission were to end after 100 years, the federal government would still have an obligation to provide adequate institutional controls at areas that pose a significant health or safety risk to the public and workers until that risk diminishes to an acceptable level for the intended purpose.

The DEQ has made it clear that their expectation for the end state for the Snake River Plain Aquifer at the INL is full compliance with Idaho groundwater quality standards. It may be difficult to achieve this at some facilities, notably INTEC and RWMC. DOE has initiated discussions with the DEQ regarding establishing points of compliance at locations that include a reasonable buffer zone between the source of contamination and point of compliance. From a risk-based perspective, establishing points of compliance downstream of a reasonable buffer zone would make sense.

Since the Snake River Plain Aquifer is the sole source of drinking water for most of the people in southeast Idaho, protection of the aquifer is a primary concern for regulatory agencies and the public.

4.2.2.5 Current State. Figure 4-11 shows the current extent of contaminant plumes at the INL. Only those constituents above the Idaho groundwater quality standards (or MCLs) for each facility are plotted. These plumes have generally reached a state of equilibrium with natural processes of diffusion, dispersion, sorption, and decay and appear stagnant or, in the case of tritium, appear to be retreating. The outermost contour value and constituent for each plume are listed in Table 4-3. In addition to the plumes shown, one monitoring well at INTEC is above MCLs for technetium-99, a few monitoring wells located within 500 ft of the former injection well at TAN are above MCLs for short-lived radionuclides such as strontium-90 and cesium-137, two monitoring wells at CFA are above MCLs for nitrate, and four wells at RWMC are above MCLs for carbon tetrachloride. Groundwater contamination is further discussed in Sections 4.3–4.8.

Table 4-3. Idaho National Laboratory Sitewide groundwater plumes—current state outermost contour values and constituents.

Location	Contaminant	Contoured Value at Outer Edge of Plume (maximum contaminant level)
Test Area North	Trichloroethene	5 μg/L
Test Reactor Area	Chromium	100 μg/L
Idaho Nuclear Technology and Engineering Center	Strontium-90	8 pCi/L

Contaminated perched water has been identified at INTEC, TRA, and RWMC. Contaminated perched water exceeding MCLs will not be used for human consumption, and, therefore, the distribution of contaminants in perched water is not shown on a summary map. The preferred remedial action for sites with contaminated perched water is to remove or isolate the source of surface water contributing to the perched zone. Uncontaminated perched water may continue to be present because of the influence of the Big Lost River.

4.2.2.6 *End State.* Although active cleanup at the INL Site is expected to be completed by 2035, remediation of the aquifer at some sites is expected to continue beyond that date. CERCLA decisions and selection of remedies have been based on no contaminants above MCLs remaining in the aquifer after 2095. CERCLA 5-year reviews are conducted to evaluate progress toward the remedial action objectives. If trends indicate that the remedial action objective may not be achieved, additional remediation actions will be identified as required by CERCLA. There are no contaminant plumes shown on Figure 4-12 because all COCs are expected to be below MCLs at the points of compliance by 2095. The ability to reduce COCs below MCLs was one of the considerations used to select the CERCLA remedies.

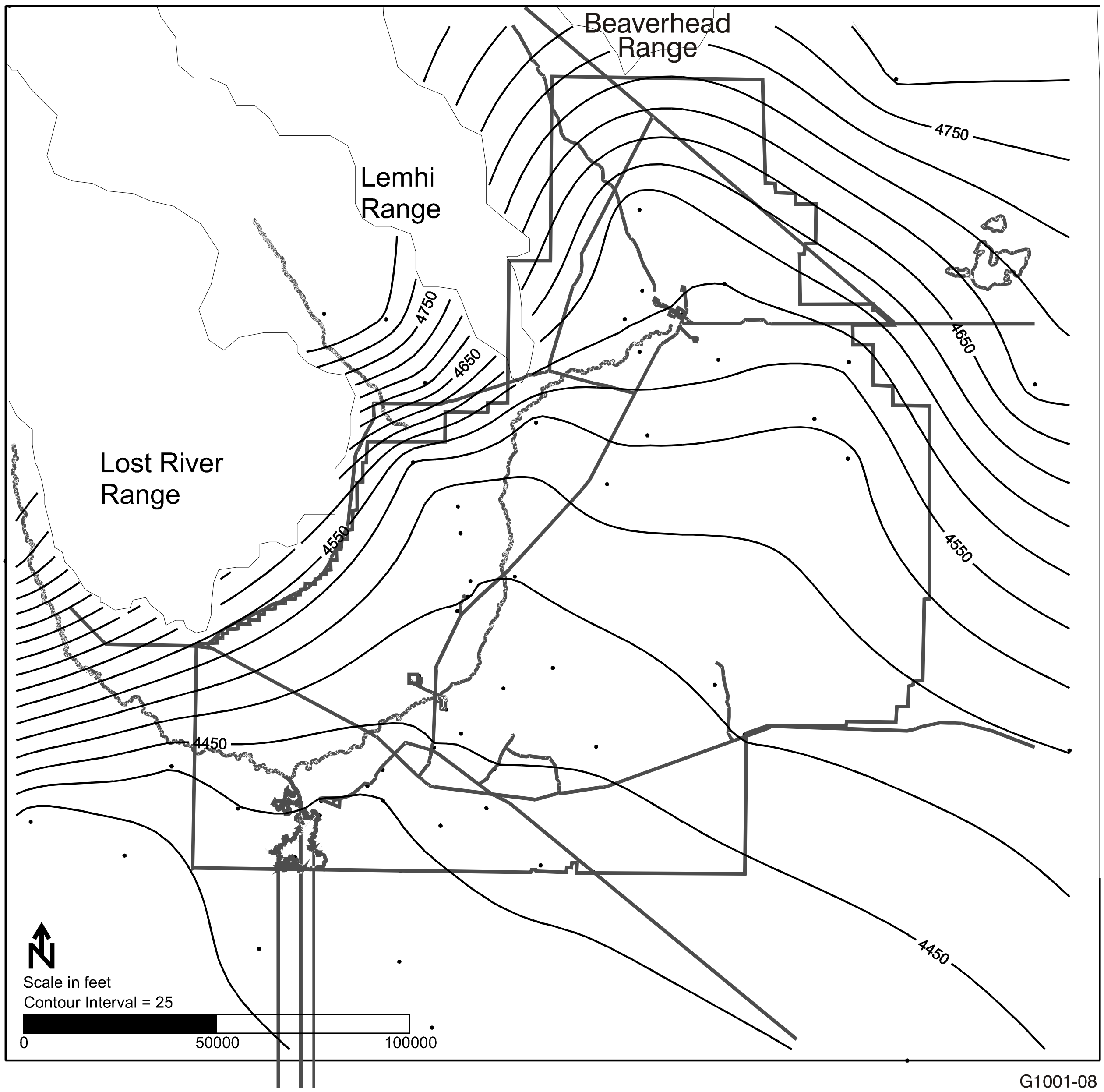


Figure 4-10. Idaho National Laboratory water table.

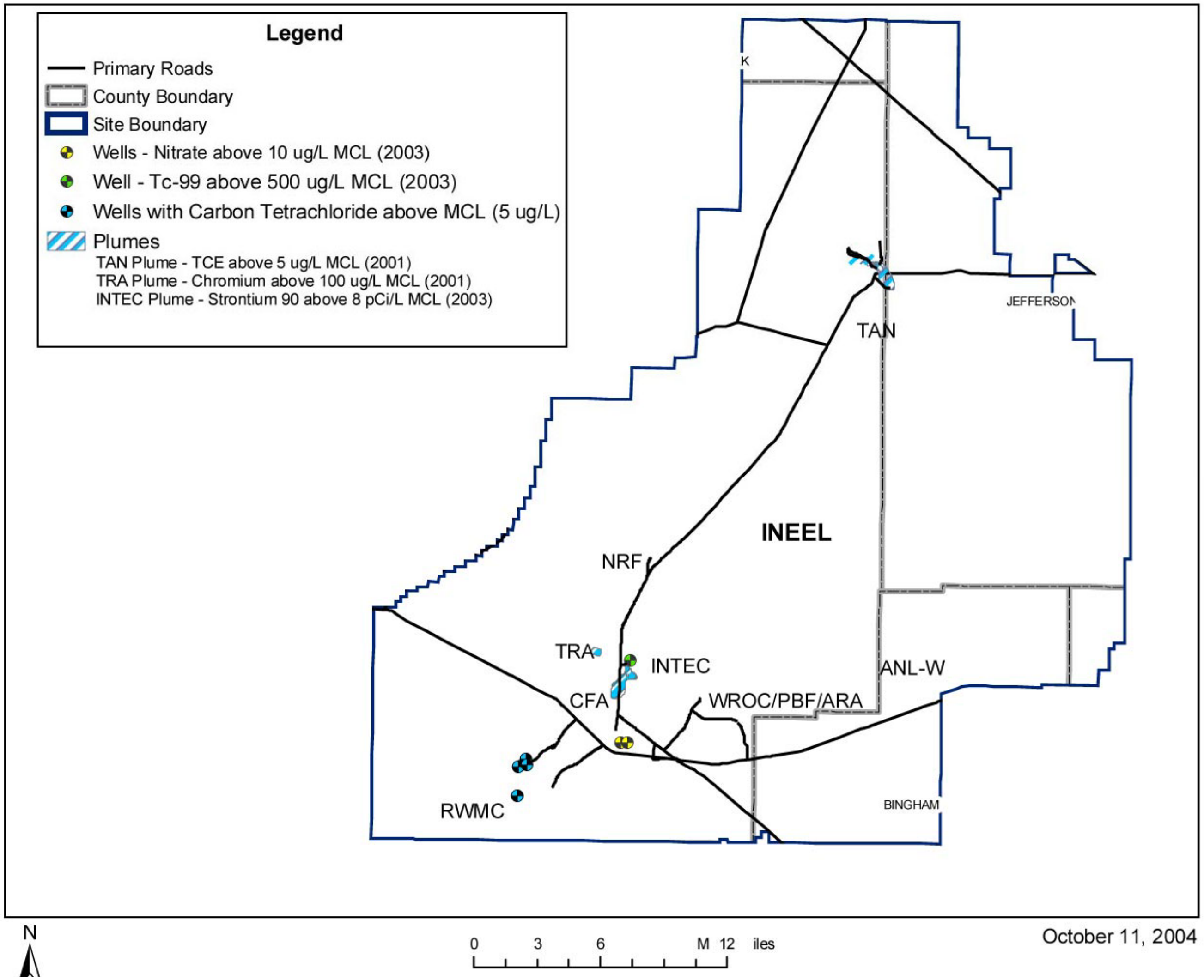


Figure 4-11. Sitewide groundwater map—current state.

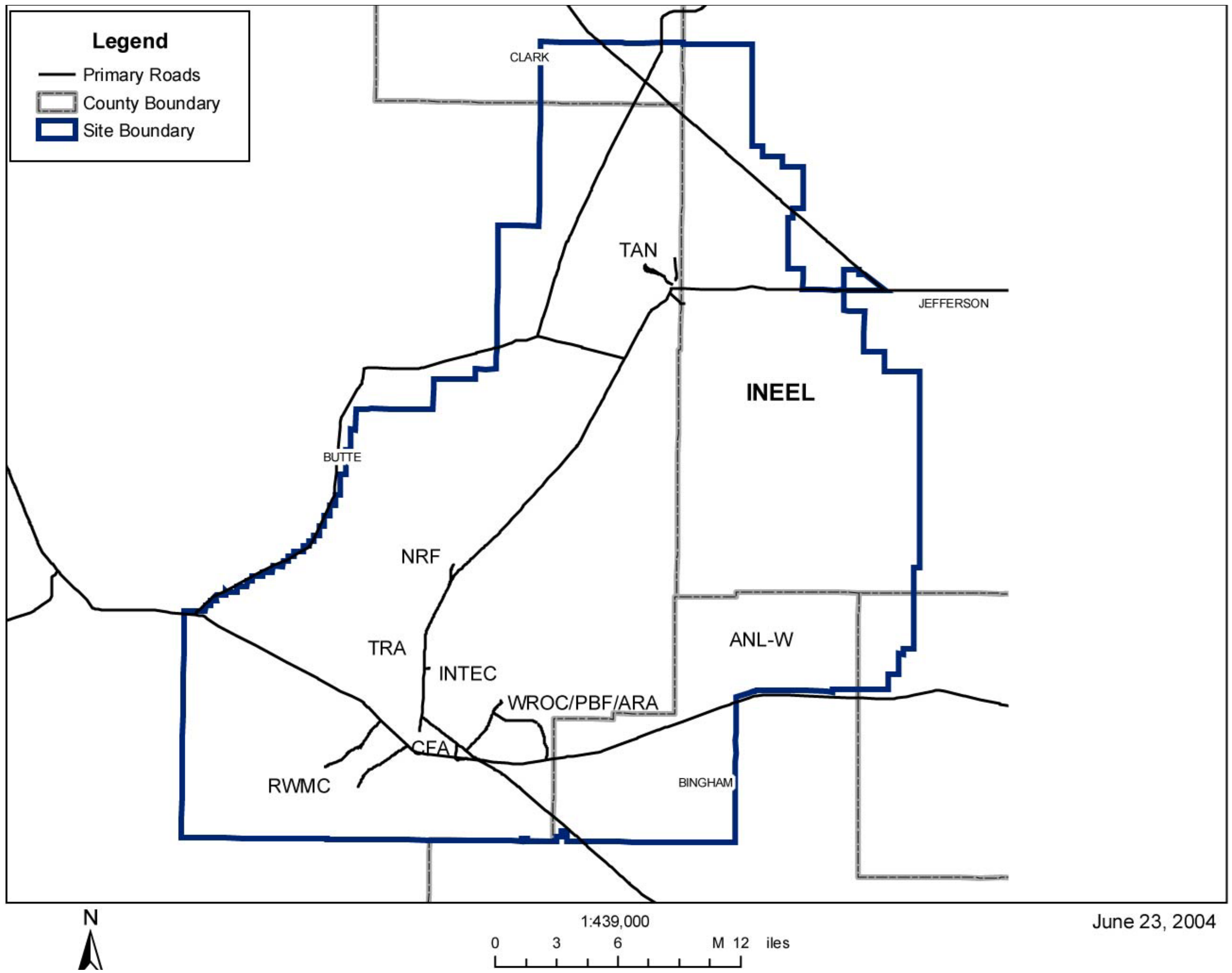


Figure 4-12. Sitewide groundwater map—end state.

4.3 Test Area North

Test Area North (TAN) was established in 1951 by the U.S. Air Force and Atomic Energy Commission Aircraft Nuclear Propulsion Program to support nuclear-powered aircraft research. TAN is located approximately 50 miles northwest of Idaho Falls in the northern portion of the INL and extends over an area of approximately 12 square miles (see Figure 4-13). TAN is composed of two active operations areas: the Contained Test Facility and the Technical Support Facility (TSF). The third and fourth areas, the Water Reactor Research Test Facility (WRRTF) and the Initial Engine Test area, are inactive. TAN also maintains a fire station and a cafeteria.

The major program now located at the Contained Test Facility is the Specific Manufacturing Capability, which develops and produces tank armor for the U.S. Army. This program has a long-term mission and is managed by NE.

Remedial actions for TAN were evaluated in the following documents:

- *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (Blackmore et al. 1997)

- *Remedial Investigation Final Report with Addenda for the Test Area North Groundwater Operable Unit 1-07B at the Idaho Nuclear Engineering and Environmental Laboratory* (Kaminsky et al. 1994).

The following three RODs exist for TAN:

- *Record of Decision for the Technical Support Facility (TSF) Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23), Operable Unit 1-07A* (DOE-ID 1992b)

- *Record of Decision: Declaration for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action, Operable Unit 1-07B* (hereinafter referred to as the OU 1-07B ROD) (DOE-ID 1995c)

- *Final Record of Decision for Test Area North, Operable Unit 1-10* (hereinafter referred to as the OU 1-10 ROD) (DOE-ID 1999a).

A ROD amendment for OU 1-07B, signed in September 2001, is titled *Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (DOE-ID 2001b). An *Explanation of Significant Differences for the Record of Decision for the Test Area North Operable Unit 1-10* (DOE-ID 2003b) was signed in April 2003. A ROD amendment for OU 1-10, signed in February 2004, is titled *Record of Decision Amendment for the V-Tanks (TSF-09 and TSF-18) and Explanation of Significant Differences for he PM-2A Tanks (TSF-26) and TSF-06, Area 10, at Test Are North, Operable Unit 1-10* (DOE-ID 2004d).

Figure 4-13. Aerial view of the Technical Support Facility at Test Area North with the Contained Test Facility in the background.

4.3.1 Current State

Maps showing current hazards at TAN are shown in Figures 4-14 and 4-15.

Of the 94 potential CERCLA release sites addressed in the OU 1-10 ROD (DOE-ID 1999a), 83 were determined not to pose an imminent and substantial endangerment to human health and the environment based on a residential scenario. Of these 83 CERCLA sites, 77 are No Action and six (plus three subareas of TSF-06) are No Further Action. The OU 1-10 ROD (DOE-ID 1999a) addresses remedial actions for seven identified release sites within TAN that may present an imminent and substantial endangerment to human health and the environment. These sites include:

- Intermediate-Level (Radioactive) Waste Disposal System (TSF-09) and Contaminated Tank Southeast of Tank V-3 (TSF-18), referred to as the V-Tanks
- PM-2A Tank Contents and Contaminated Soils (TSF-26), referred to as the PM-2A Tanks
- TAN/TSF-1 Area (Soil Area) (TSF-06, Area B)
- TAN Disposal Pond (TSF-07)
- TSF Burn Pit (TSF-03) and WRRTF Burn Pits I, II, III, and IV (WRRTF-01).

One site, the WRRTF Diesel Fuel Leak (WRRTF-13), was originally identified in the OU 1-10 ROD (DOE-ID 1999a) as requiring remediation; however, more comprehensive post-ROD sampling determined that this site should be changed to No Action.

A conceptual site model was developed as part of the *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (Blackmore et al. 1997) and the *Comprehensive Remedial Investigation and Feasibility Study Supplement for the Test Area North Operable Unit 1-10 at the Idaho*

National Engineering and Environmental Laboratory (DOE-ID 1998a). This model, which has been updated to reflect 2004 conditions, is shown in Figure 4-16.

The following list includes TAN sites that are currently under institutional control:

- IET-04 Stack Rubble Pit—IET-04 contains buried rubble from the Initial Engine Test exhaust stack and monitoring vault. The rubble was buried 15–20 ft below ground after decontamination and decommissioning in 1986 and 1987. The COCs are radionuclides, with the contamination assumed to be fixed to the buried stack rubble. Suspected concentrations pose risks greater than 1 in 10,000. The baseline risk assessment does not include any risk calculations for this site because human and ecological receptors are not expected to ever become exposed to the site's contamination.

- TSF-03 Burn Pit—Remediation was completed in June 2004, and confirmatory sampling verified that remediation goals had been met. The ROD selected remedy was removal of contaminated soil; disposal at ICDF; and backfill, contouring, and revegetation. Revegetation will take place in November 2004. The COC for this site is lead. It is anticipated that institutional controls will be discontinued during the next 5-year review.

- TSF-05 Injection Well—The principal source of groundwater contamination at TAN has been identified as the TSF injection well. The well was drilled in 1953 and completed to a depth of 305 ft. The well was used to dispose of liquid effluent until 1972. Discharges to the TSF-05 well included treated sanitary sewage, process wastewaters, and low-level radioactive waste streams. Hazardous waste disposed of in the well included corrosive and ignitable waste from shop operations and potentially corrosive and toxic condensate. Releases to TAN groundwater were first identified as a problem in 1987, when low levels (up to 8 ppb) of trichloroethene (TCE) and tetrachloroethene (PCE) were found in the production wells that supply drinking water to TSF. To reduce the concentrations of TCE and PCE in the drinking water and to mitigate potential risks to personnel at TAN, an air sparging system was installed on the drinking water system. The COCs in the immediate vicinity of the TSF injection well, as identified in the OU 1-07B ROD (DOE-ID 1995c), include TCE; PCE; cis-1,2-dichloroethene; trans-1,2-dichloroethene; tritium; strontium-90; cesium-137; and uranium-234.

- TSF-06, TAN/TSF Soil Area—The TSF soil area is a large potentially contaminated area, approximately 1,200 × 1,200 ft, which includes surface ponds, drainage ditches, railroad tracks, and large areas used for open storage of equipment. The TSF-06 area has been subdivided into smaller units described below.

  - TSF-06, Area 1—This site is a large open soil area used since the 1950s for the storage of radioactive equipment. The equipment, left uncovered, resulted in soil contamination because of exposure to precipitation and wind. The contaminated area is approximately 600 × 400 ft. The COCs include cobalt-60, cesium-137, thorium-232, and uranium-238. This is a No Further Action site and will remain under institutional control until the radionuclides decay to levels acceptable for unrestricted use.

  - TSF-06, Area 5, TAN/TSF Soil Area, Radioactive Soil Berm—This site measures approximately 3 ft high, 150 ft long, and 10 ft wide. It is believed this berm was created in 1986 when a 137-m^2 area in the southeast portion of TSF-06 was scraped clean to allow construction of two new storage pads. The depth of the radioactively contaminated interval is conservatively estimated to be the height of the berm (3 ft). The COC is cesium-137. This is a No Further Action site and will remain under institutional control until the radionuclides decay to levels acceptable for unrestricted use.

- TSF-06, Area 10, Buried Heat Transfer Reactor Experiment Vessel Site—Contamination is fixed to the surfaces of an empty, irradiated reactor vessel that was buried inside a metal storage vault located more than 10 ft below ground. Although no information is available concerning the specific contaminants associated with the reactor vessel and storage unit, it is likely that the primary contaminants are cesium-137, cobalt-60, and strontium-90, the radioactive contaminants most often associated with processes at TAN. Although no pathway exists to human or ecological receptors, residual contamination at this site precludes unrestricted land use. This is a No Further Action site. Institutional controls are required to prevent intrusion.

- TSF-06, Area 11, TAN/TSF Soil Area, TSF-06 Ditch—This site runs east-west through TSF-06, originating at the north end of TAN-607, TAN-615, TAN-616, and TAN–633. The ditch, which is approximately 900 ft long, consists of two arms. The ditch empties storm water run-off from the TSF-06 area into the TSF-29 pond. This area was partially remediated during a previous removal action. The COC is cesium-137. This is a No Further Action site and will remain under institutional control until the radionuclides decay to levels acceptable for unrestricted use.

- TSF-06, Area B, TAN/TSF Soil Area—This open soil area, bound by the facility fence on the west and facility roads on the east and south, is roughly triangular and measures approximately 675 ft wide on the southern base and 425 ft wide on the western boundary. Surface soil in the area was radioactively contaminated because of the windblown deposition of radioactive particles from the PM-2A Tank area, south of the site. The COC was cesium-137. Remediation was completed in June 2004, and confirmatory sampling verified that remediation goals were met. The selected remedy was excavation and disposal. The area will be revegetated in November 2004. Institutional controls will be maintained until the residual cesium-137 decays to levels acceptable for unrestricted use.

• TSF-07 Disposal Pond—This site is an unlined disposal pond located southwest of TSF. The TSF-07 site encompasses a total area of approximately 35 acres, of which 5 acres in the northeast corner and along the eastern edge are believed to be contaminated. The remaining 30 acres have never received wastewater and are not contaminated based on available screening data. The active portion of the pond consists of 1.5 acres along the eastern edge. The pond received wastewater from a variety of sources including sanitary waste discharges, low-level radioactive waste, cold process water, and treated sewage effluent originating from TAN service buildings and processes and, more recently, a one-time release of 40,000 gal of treated wastewater from TAN-726. The COC is cesium-137. For the TAN disposal pond (TSF-07), the selected remedy is Limited Action, which includes soil sampling at the end of use to determine the levels of cesium-137 present. The pond will undergo assessment when operations cease. Maintenance of existing institutional controls and environmental monitoring will continue until discontinued during a 5-year review.

• TSF-08 Heat Transfer Reactor Experiment III Mercury Spill Sites 13B and 13C—It is reported that mercury leaked from the Heat Transfer Reactor Experiment III engine onto the ground and railroad system every time the unit was moved and that mercury beads were found on the soil near the TAN-647 storage location in the mid-1980s. The COC is mercury.

• TSF-09 TSF Intermediate-Level (Radioactive) Waste Disposal System—The V-Tank and PM-2A Tank systems were used from 1958 until the early 1980s to collect and store liquid radioactive waste at TAN. The waste was stored in the V-Tanks before it was treated in the evaporator system located in TAN-616. Residues from the TAN-616 treatment process were sent to the PM-2A Tanks for storage (see TSF-26). The TSF-09 site consists of three abandoned, 10,000-gal, underground storage tanks that were once part of the TSF intermediate-level radioactive waste disposal system. Waste collected in the tanks, referred to as V-1, V-2, and V-3, was treated in the evaporator system located in TAN-616. Surface soil surrounding the tanks reportedly became contaminated because of spills during operation of the tanks and from run-off from an adjacent cask storage pad. The COC for TSF-09 is cesium-137. The three tanks contain mixed waste, which contains (1) nonradionuclides: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, tin, vanadium, zinc, cyanide, fluoride, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, acetone, Aroclor-1254, Aroclor-1260, benzo(a)pyrene, benzo(g,h,I)perylene, bis(2-ethylexyl)phthalate, carbon disulfide, diethylphthalate, di-n-butylphtalate, ethylbenzene, fluoranthene, fluorene, methyl ethyl ketone, methylene chloride, phenanthrene, tetrachloroethylene, toluene, TCE, and xylene and (2) radionuclides: silver-108m, americium-241, curium-243, cobalt-60, cesium-137, europium-152, europium-154, europium-155, tritium, potassium-40, niobium-94, nickel-63, plutonium-238, plutonium-239, radium-226, strontium-90, uranium-233, uranium-235, and uranium-238.

For the V-Tanks (TSF-09 and TSF-18) containing liquids and sludge, the OU 1-10 ROD (DOE-ID 1999a) was recently amended because the preferred waste disposal facility will not be available. The modified remedy includes removal of the tanks and piping, consolidation of the tank contents, and treatment of VOCs and semivolatile organic compounds by chemical oxidation; stabilization of the tank contents; and disposal of the tank contents, tanks, and piping at the ICDF. The contaminated soil will be excavated and disposed of at the ICDF. The excavation will be backfilled and contoured.

The V-Tanks are currently administratively controlled. The sites are fenced and posted with signs that identify them as CERCLA sites. Entry into the sites requires radiological control precautions. The purpose of these controls is to keep worker exposures as low as reasonably achievable and to prevent the spread of contaminated soil. As-low-as-reasonably-achievable controls reduce occupational risks at these sites to acceptable levels. Risks from the tank contents were not evaluated in the *WAG-1 OU 1-10 Comprehensive Remedial Investigation/Feasibility Study Baseline Risk Assessment Technical Memorandum* (Burns 1995) because there is no evidence to indicate that the tanks have ever leaked. Therefore, the tanks also are not included in the conceptual site models in Figures 4-16 and 4-21. A bubbler level detection system installed in the mid-1990s tracks liquid levels in tanks V-1, V-2, and V-3. Tank contents were included in the site's feasibility study evaluation because they are so highly contaminated that they would produce unacceptable human health and ecological risks if they were to escape into the environment. The V-Tanks also will undergo RCRA closure.

The need for continued institutional controls will be evaluated after remediation is complete.

- TSF-10 Drainage Pond—The TSF-10 drainage pond located at the western end of TSF was built before 1958. The pond was originally designed as an infiltration pond. Historical information indicates that the pond was usually dry, and at present, no operations or processes discharge to the pond. The pond does receive intermittent surface water run-off and occasional discharge of monitoring-well purge water. The primary COC is cesium-137. This is a No Further Action site and will remain under institutional control until the residual cesium-37 decays to levels acceptable for unrestricted use.

- TSF-18 Contaminated Tank Southeast of Tank V-3—The TSF-09 and TSF-18 sites are situated in an open area east of TAN-616 and north of TAN-607. The tank at TSF-18, referred to as V-9, is a 400-gal stainless steel sump tank located approximately 7 ft below ground. The conical tank is 3 ft in diameter in the center and extends approximately 7 ft down to the tip of the cone. The tank contains approximately 3 ft of sludge, 3 ft of liquid, and 1 ft of head space. Radiation readings in the tank range from 9 mrem/hour on contact just inside the 6-in. riser to 10,500 mrem/hour just inside the tank. The COC for TSF-18 is cesium-137. The waste in the tank contains (1) nonradionuclides: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, tin, vanadium, zinc, cyanide, fluoride, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, acetone, Aroclor-1254, Aroclor-1260, benzo(a)pyrene, benzo(g,h,I)perylene, bis(2-ethylexyl)phthalate, carbon disulfide, diethylphthalate, di-n-butylphtalate, ethylbenzene, fluoranthene, fluorene, methyl ethyl ketone, methylene chloride, phenanthrene, tetrachloroethylene, toluene, TCE, and xylene and (2) radionuclides: silver -108m, americium-241, curium-243, cobalt-60, cesium-137, europium-152, europium-154, europium-155, tritium, potassium-40, niobium-94, nickel-63, plutonium-238, plutonium-239, radium-226, strontium-90, uranium-233, uranium-235, and uranium-238 (see additional discussion under TSF-09).

- TSF-23 Contaminated Groundwater Beneath TSF—Contamination from TSF-05 resulted in the contaminated groundwater designated as TSF-23 (see bullet on TSF-05).

- TSF-26 PM-2A Tanks—The PM-2A Tanks, two abandoned 50,000-gal underground storage tanks, were used from when they were installed in approximately 1955 until 1972 to store concentrated low-level radioactive waste from the TAN-616 evaporator. In 1972, an evaporator system (the PM-2A Tank system) was installed in the TSF-26 area to replace the failing system in TAN-616. Surrounding soil above the tanks was contaminated by spills containing cesium-137 when waste was transferred from the tanks. Results of sampling and analysis indicate that many contaminants found in the V-Tanks also are present in the PM-2A Tanks, although generally at lower concentrations. The COC for TSF-26 is cesium-137. The waste in the PM-2A Tanks contains (1) nonradionuclides: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, tin, vanadium, zinc, cyanide, fluoride, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, acetone, Aroclor-1254, Aroclor-1260, benzo(a)pyrene, benzo(g,h,I)perylene, bis(2-ethylexyl)phthalate, carbon disulfide, diethylphthalate, di-n-butylphtalate, ethylbenzene, fluoranthene, fluorene, methyl ethyl ketone, methylene chloride, phenanthrene, tetrachloroethylene, toluene, TCE, and xylene and (2) radionuclides: silver-108m, americium-241, curium-243, cobalt-60, cesium-137, europium-152, europium-154, europium-155, tritium, potassium-40, niobium-94, nickel-63, plutonium-238, plutonium-239, radium-226, strontium-90, uranium-233, uranium-235, and uranium-238.

  In June 2004, the PM-2A Tanks were removed, with contents intact, from the TSF-26 site and are currently stored in the TAN-607 building. The plan is to remove, treat (as required), and package the contents for disposal at ICDF. The tanks also will undergo RCRA closure. Remediation of the TSF-26 soil site was completed in September 2004. Institutional controls will be maintained for less than 100 years to allow residual cesium-137 to decay to levels acceptable for unrestricted use.

- TSF-28 Sewage Treatment Plan and Sludge Drying Beds—The sewage treatment plant received small quantities of paint thinner and radioactive contamination. Cobalt-60 and cesium-137 were determined to pose an acceptable risk. The *Preliminary Scoping Track 2 Summary Report for the Test Area North Operable Unit 1-05: Radioactive Contamination Sites* (INL 1994) determined the site needed further evaluation; however, a verbal agreement between the agencies during preparation of the *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (Blackmore et al. 1997) classified the site as No Further Action. The COC is radionuclides. Institutional controls will be maintained until the residual cesium-137 decays to levels acceptable for unrestricted use.

- TSF-29 Acid Pond—The TSF-29 Acid Pond is an unlined drainage pond located within the boundaries of the TSF-06 radioactive soil area. Site investigations, field surveys, and soil data indicate random, isolated radioactive particles in the backfilled soil. The COC is cesium-137. This is a No Further Action site and will remain under institutional control until the residual cesium-137 decays to levels acceptable for unrestricted use.

- TSF-39 Transite (Asbestos) Contamination—The area contains small pieces of asbestos cement. Inspections have determined that the asbestos is tightly encapsulated in cement and is not likely to be released; however, friable asbestos may be released if pulverized or crushed. The COC is asbestos. This is a No Further Action site. Institutional controls are required to prevent intrusion.

- TSF-42 TAN-607 Room-161 Contaminated Pipe—The pipe is internally contaminated with radioactive material, surrounded by concrete, and located under the floor of Room 161 in TAN-607A. The contamination is fixed, and no environmental releases have occurred. The COC is radionuclides. This is a No Further Action site. Institutional controls are maintained to prevent intrusion.

- TSF-43 Radioactive Parts Security Storage Area Buildings 647 and 648 and pads—The TAN-647 building was used as an interim status storage unit for certain hazardous waste under the INL RCRA Interim Status Program. TAN-647 was closed under RCRA in January 2004, and TAN-647 and TAN-648 were demolished in the spring of 2004. The asphalt pads that surrounded the buildings still remain. These pads cover and fix radioactive contaminated soil, causing this site to be considered a possible release site if disturbed. The COC is radionuclides. This is a No Further Action site and will remain under institutional control to prevent intrusion until the residual cesium-137 decays to levels acceptable for unrestricted use.

- TSF-46, TAN-616 soil—This site was identified in 1998. A New Site Identification Form was approved by the agencies in 1998. Remediation will be conducted concurrently with the demolition of the TAN-616 facility and the excavation of TSF-09/18 V-Tank soil. Contaminated soil will be excavated and disposed of in the ICDF. The excavated area will be backfilled with clean fill. After DD&D and remediation activities at TAN have been completed, the area will be revegetated with a grass mixture compatible with the INL ecosystem.

- TSF-47, TAN-615 sewer-line soil—A damaged sewer line was discovered during DD&D and excavation of the north end of TAN-615. Work crews identified soil overlaying a damaged sanitary sewer line that was radiologically contaminated. A New Site Identification Form was approved by the agencies in 2004. The sewer line is approximately 10 ft below ground. The surface soil will be excavated in conjunction with the excavation of the V-Tanks soil and stockpiled pending shipment to ICDF. The contaminated soil around the sewer line will be sampled, excavated, and, if necessary, stockpiled before shipment to ICDF. The excavated area will be backfilled with pit-run soil and gravel from the TAN borrow pit. The area will be revegetated with a grass mixture compatible with the INL ecosystem.

- TSF-48, soil beneath TAN-615 east and west sumps—The south half of TAN-615 contained two pits: an east pit/sump and a west pit/sump. The soil beneath the east and west pits/sumps was characterized and determined to be radiologically contaminated. A New Site Identification Form was approved by the agencies in 2004. Remediation will be conducted concurrently with the demolition of the TAN-616 facility and the excavation of TSF-09/18 V-Tank soil. Contaminated soil will be excavated and disposed of in the ICDF. The excavated area will be backfilled with clean fill. After DD&D and remediation activities at TAN have been completed, the area will be revegetated with a grass mixture compatible with the INL ecosystem.

- WRRTF-01 Burn Pits II and IV—The burn pits were used for open burning of combustible waste generated at the TAN facilities from 1958 to 1975. The OU 1-10 ROD (DOE-ID 1999a) required native soil covers on WRRTF-01 Burn Pits I, II, and IV. This was based on initial indications that lead concentrations were above the Region 9 residential preliminary remediation goal of 400 mg/kg from the Track 2 investigation. However, post-ROD sampling determined that lead concentrations at these sites were below the EPA Region 9 residential preliminary remediation goal for all four pits (DOE-ID 2003b). During the post-ROD characterization, asbestos levels in Pits II and IV were measured above action levels. Therefore, the COC is asbestos. Asbestos at concentrations greater than 1% by volume is a regulatory and health and safety concern. The selected remedy consisted of the application of a soil cap over Burn Pits II and IV with revegetation and institutional controls based on the presence of asbestos above action levels. The remedy also included placement of permanent granite monuments. Pits I and III no longer require remediation (soil covers) or institutional controls and were changed to No Action sites. Remediation of Burn Pits II and IV was completed in July 2004. Long-term institutional controls will be needed at this site to prevent intrusion.

Additional details on contamination and risk levels at these sites are presented in Tables 4-4 and 4-5.

The depth to the water table at TAN varies from 200 to 250 ft. The aquifer thickness is at least 900 ft. The local direction of aquifer flow is generally to the south-southeast. Aquifer flow velocity at TAN is about 0.5 ft/day, much slower than average for the INL. The aquifer is locally recharged, to a minor degree, by Birch Creek and the TSF waste disposal pond. The only known perched water zone is about 45 ft beneath the disposal pond. The perched water, which is not known to have significant contamination, is small in volume and area and is expected to dissipate once use of the pond is discontinued.

The OU 1-07B ROD (DOE-ID 1995c) addresses remedial action for the TSF injection well (TSF-05) and surrounding groundwater contamination (TSF-23). The TSF injection well was used from 1953 to 1972 to dispose of TAN liquid waste into the fractured basalt of the Snake River Plain Aquifer. This waste included organic, inorganic, and low-level radioactive wastewater added to industrial and sanitary wastewater. The contaminants identified at concentrations above risk-based levels in the groundwater are organic TCE; cis- and trans-1,2-dichloroethene; and radionuclides (strontium-90, tritium, cesium-137, and uranium-234). OU 1-07B is defined as the groundwater beneath TAN that has, or is expected to have, concentrations of TCE above the Safe Drinking Water Act MCL. TCE is being used as the indicator constituent for defining the groundwater plume because it is the most widely distributed COC in TAN groundwater. The highest groundwater contaminant concentrations are found near the TSF injection well but drop rapidly as the distance from the injection well increases. In the 40 years since injection well operations began, the TCE appears to have traveled 1-1/2 miles in the direction of groundwater flow (south to southeast). Although TCE is used to define the boundaries of the plume, short-lived radionuclides, such as strontium-90 and cesium-137, are also above MCLs in monitoring wells within 500 ft of the injection well site. These radionuclides will decay below MCLs within 100 years.

The aquifer at TAN appears to be unconfined, although locally confined conditions may exist because of the presence of sedimentary interbeds or dense, relatively impermeable basalt flows. The most significant sedimentary interbed at TAN occurs at about 410 ft below land surface at the TSF-05 well. This interbed ranges in thickness from about 8 ft to more than 20 ft and is laterally continuous and extensive. All evidence gathered to date suggests that this interbed effectively isolates the aquifer below it from the water above it. It is important to note that the interbed slopes at about 1 degree in a southerly direction; thus, the thickness of the aquifer above the interbed at TAN increases from about 200 ft near the TSF-05 well to more than 300 ft at the leading edge of the TCE plume.

In 1990, INL personnel removed sludge, containing very high concentrations of many contaminants, that had built up in the bottom 55 ft of the TSF-05 injection well. A pump-and-treat system began operating at the TSF-05 injection well in February 1994. Several modifications to the treatment methodology were made between 1994 and November 1998, when field evaluation of in situ bioremediation for hot spot cleanup was initiated. This evaluation continued through 2000 to determine the rate at which bioremediation breaks down organic chemicals within the aquifer and to evaluate its effectiveness on the hot spot. Bioremediation was determined to be successful and was chosen as the preferred hot spot cleanup remedy. The pump-and-treat system will continue to be used in the medial zone. MNA of the distal zone is the preferred cleanup remedy. Initial results of bioremediation at TAN have been very promising. TCE concentrations in monitoring wells near the hot spot have decreased significantly.

Exposure scenarios evaluated in the *Remedial Investigation Final Report with Addenda for the Test Area North Groundwater Operable Unit 1-07B at the Idaho Nuclear Engineering and Environmental Laboratory* (Kaminsky et al. 1994) considered industrial and residential long-term (chronic) exposures. Chronic exposures evaluated assumed contaminant exposures to workers over a 200-year period and to residents living in the study area over a 30-year period. The groundwater conceptual site model from the baseline risk assessment was updated to reflect 2004 conditions and is shown in Figure 4-17.

TAN also has a number of tanks and other items identified as requiring characterization or closure under RCRA as identified in the VCO between the Idaho Department of Health and Welfare and the DOE. RCRA closure is the required action for TAN-616 Low-Level Radioactive Waste System (VCO number TAN-008) and tanks identified in VCO number TAN-005, including TAN-020 Heat Transfer Reactor Experiment Mercury Contamination Sump (Loss-of-Fluid Test Facility) and TAN-031 TSF Demineralized Water System.

4.3.2 End State

Maps showing the end state for TAN are shown in Figures 4-18 and 4-19.

By 2021, all facilities at TAN with no identified future use will be dispositioned. The facilities at WRRTF were demolished in 2004. The bulk of the Loss-of-Fluid Test Facility will be deactivated and decommissioned by 2009. TAN-607 Hot Shop will be deactivated by 2012 and decommissioned by 2014, with all remaining decommissioning at TAN completed by 2020 (not including NE-owned buildings). Items that pose no threat to occupants or that provide utilities to occupants will remain. These include roads, railroad tracks, drainage wells, drainage ponds, electrical substations, parking lots, paved lay-down areas, concrete or asphalt pads, fences, utility poles, utility lines, foundations below grade, uncontaminated underground piping, and berms.

There are four buildings at TAN that have been designated as signature properties for their historic significance. They are TAN-607 (Manufacturing and Assembly Building), TAN-629 (Nuclear Airplane Hanger), TAN-630 (Loss-of-Fluid Test Control Building), and TAN-650 (Loss-of-Fluid Test Dome). The final disposition of these buildings has not yet been determined. It is possible that some of these buildings may be preserved for their historic value.

Remediation of sites under the OU 1-10 ROD (DOE-ID 1999a) is planned to be completed by 2005, with the exception of potential contaminated soil under buildings or structures (i.e., collocated facilities). The following sites may require institutional controls beyond 2035, depending on results of the 5-year reviews: IET-04, TSF-06 Area 10, the TSF-07 Disposal Pond, the TSF-09 and TSF-18 V-Tanks soil area, the TSF-26 PM-2A Tanks soil area, the WRRTF-01 Burn Pits, the TSF-08 Mercury Spill Area, the TSF-10 Drainage Pond, and the TSF-39 TSF Transite Contamination Area. Institutional controls consist of visible access restrictions, control of activities, and prevention of well drilling. During DOE control postoperations, the controls will consist of access restrictions and control of activities and property lease requirements including control of land use if required based on results of remedial action. Institutional controls will be maintained until the site is released based on documentation in a 5-year review. If additional potential release sites are identified during remediation activities, they will be reviewed under the INL new site identification process. An end state conceptual site model is shown in Figure 4-20.

Cleanup of TAN groundwater involves application of three technologies to remediate three zones of the contaminated plume: in situ bioremediation (hot spot), pump and treat (medial zone), and MNA (distal zone). To implement the in situ bioremediation process, sodium lactate is injected into the aquifer to stimulate naturally occurring microbes in the subsurface to digest and break down contaminants. Pump-and-treat technology is used to extract contaminated groundwater from the aquifer, treat it to remove the hazardous constituents, and reinject clean water back into the aquifer. MNA takes advantage of naturally occurring bacteria to break down the hazardous waste chemical, TCE, into harmless end products.

By 2035, the in situ bioremediation and pump-and-treat portions of the remedy will be complete, and MNA will be ongoing. Institutional controls will be maintained until the entire plume reaches the remedial action objectives identified in the *Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (DOE-ID 2001b). Analysis of groundwater data collected from 1989 to 1997 provided the basis for recommending MNA. By comparing TCE concentrations in the distal zone to those of two other contaminants, PCE and tritium, it has been determined that TCE is degrading at a rate that will meet cleanup objectives. The timeframe identified for all remediation activities to be complete and for the plume to meet remedial action objectives is 2095. An end state conceptual site model is shown in Figure 4-21.

4.3.3 Risk Assessment Summary

Risk assessment information for TAN CERCLA sites is published in the *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (Blackmore et al. 1997) and in the *Remedial Investigation Final Report with Addenda for the Test Area North Groundwater Operable Unit 1-07B at the Idaho Nuclear Engineering and Environmental Laboratory* (Kaminsky et al. 1994).

Two scenarios, residential and occupational, evaluated relevant exposure pathways. For example, in the case of the residential scenario with subsistence farming, the evaluation included ingestion of contaminated soil, groundwater, and homegrown produce; inhalation of VOCs and contaminated dust; external radiation; skin adsorption; and indoor water use.

4.3.3.1 Human Health Risk Assessment. The human health risk assessment quantified potential carcinogenic (cancer-causing) and noncarcinogenic adverse health effects. The assessment was based on a hypothetical residential scenario. This scenario assumed a loss of institutional control, after which a resident might occupy the contaminated site in 100 years and engage in subsistence farming. This scenario is believed to allow for all impacts of any reasonably anticipated future land use. The assessment also examined the potential risk to current and future workers.

The two scenarios, residential and occupational, evaluated relevant exposure pathways. For example, in the case of the residential scenario with subsistence farming, the evaluation included ingestion of contaminated soil, groundwater, and homegrown produce; inhalation of VOCs and contaminated dust; external radiation; skin adsorption; and indoor water use.

The groundwater risk estimates were developed by taking into account various assumptions about the frequency and duration of an individual's exposure to the contaminated groundwater, as well as knowledge about the toxicity of TCE, PCE, and 1,2-dichloroethene. The excess cancer risk to an individual posed by TCE in the groundwater could be as high as two in 1,000. The acceptable level is one in 10,000. The HI, which measures potential adverse health effects other than cancer, is 23. A HI greater than 1 indicates that remediation is required. The current land-use scenario evaluated the industrial use of groundwater from the TAN production wells (i.e., TAN-1 and TAN-2) as if the water was not treated through the existing air sparger. The evaluation of the current industrial-use scenario assumed two exposure scenarios for workers and visitors. These included the use of groundwater from TAN production wells for drinking and showering (i.e., inhalation). For future residential scenarios, it was assumed that a family would occupy the area and engage in agricultural activities, such as the irrigation of crops, livestock watering, and domestic activities and would use water pumped from the Snake River Plain Aquifer. The future residential-use scenario was evaluated for three time periods in the future: 2024, 2040, and 2094. The residential-use scenario consisted of two different future land-use cases. One of the land-use cases assumed that groundwater from within the plume will be used by residents. The other future land-use case evaluated the use of groundwater directly from the TSF injection well.

4.3.3.2 Ecological Risk Assessment. The objectives of the OU 1-10 ecological risk assessment were to define the extent of contamination for each site; determine the potential effects from contaminants on environmental receptors, habitats, or special environments; determine the potential effects from contaminants on other ecological receptors at WAG 1; and identify sites and COPCs to be further assessed in the INL-wide environmental risk assessment. This qualitative evaluation provided input to the INL-wide ecological risk assessment document in the *Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory* (Blackmore et al. 1997).

Wildlife species present in and around TAN include birds, mammals, and reptiles associated with facilities, sagebush-rabbitbrush, grasslands, salt desert shrub habitats, deciduous trees and shrubs, and water (e.g., facility ponds and drainage areas). Sagebrush-rabbitbrush, and salt desert shrub habitats support various species including sage grouse and pronghorn. Grasslands provide habitat for species such as the western meadowlark and mule deer. Buildings, lawns and ornamental vegetation, and disposal or drainage ponds are utilized by a number of species such as waterfowl, raptors, rabbits, and bats.

Sagebrush-rabbitbrush is the predominant vegetation type. Grasslands present in the area consist primarily of wheatgrasses. Wetland species are supported by intermittent standing water from facility drainage and disposal ponds. Extensive playa areas associated with the Big Lost River and Birch Creek historical drainages are found near TAN.

There are no critical or sensitive habitats on or near TAN. No threatened or endangered plant species have been recorded in the TAN area. Avian threatened, endangered, or sensitive species that have the potential for occurrence in the vicinity of TAN include the ferruginous hawk, the peregrine falcon, the northern goshawk, the loggerhead shrike, the burrowing owl, the bald eagle, the white-faced ibis, the black tern, the trumpeter swan, and the long-billed curlew black tern. Four sensitive mammal species have the potential to exist in the vicinity of TAN; these are the pygmy rabbit, Townsend's western big-eared bat, long-eared myotis, and small-footed myotis. The sagebrush lizard is the only sensitive reptile species with a potential presence at WAG 1.

HQs greater than 1 for nonradiological contaminants and 0.1 for radionuclides are considered indicative of potential adverse effects. The risk assessment determined that potential risks to ecological receptors exist at seven sites at WAG 1. The sites are LOFT-02, TSF-03, TSF-07, TSF-08, WRRTF-01, WRRTF-03, and WRRTF-13. LOFT-02, WRRTF-03, and WRRTF-13 were subsequently determined to be No Action sites. TSF-03 and WRRTF-01 have been remediated. TSF-07 is a No Further Action site, and TSF-08 still requires remediation. The remedies selected to address human health risks also will reduce the ecological risk at sites where both human health and potential ecological risks have been identified. Also, since these sites are at an industrial facility that is currently in use, they do not contain desirable or valuable habitat. It was concluded that the absence of habitat and the presence of facility activities and institutional controls minimize the exposure of ecological receptors to acceptable levels.

Table 4-4. Contaminant concentrations and risk levels for sites under institutional control at Test Area North.

Site Number	COCs	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 years	Basis for ICs and Comments
TSF-03 Burn Pit	Lead	400 mg/kg[a]	<400 mg/kg	No	No	No	No	Remediation complete.	No	Remediation goals have been met. It is expected that ICs will not be needed after the next 5-year review.
TSF-06, Area B Soil Contamination Area South of Turntable	Cesium-137	23.3 pCi/g (future residential)	<23.3 pCi/g	No	No	No	No	Remediation complete.	No	Remediation goals have been met. ICs will be required for <100 years or until discontinued in a 5-year review to allow residual cesium-137 to decay to levels appropriate for unrestricted land use.
TSF-06, Area 1 Soil Northeast of Turntable	Cesium-137, cobalt-60, thorium-232, and uranium-238	N/A	0.4–31.5 pCi/g 0.03–4.1 pCi/g 8–17 pCi/g 13–19 pCi/g	2 in 10,000	Not available	2 in 10,000	No	No Further Action site.	No	Current residential risk 1 in 1,000. ICs are required while radionuclides decay to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.
TSF-06, Area 5 Radioactive Soil Berm	Cesium-137	N/A	11–13.4 pCi/g	9 in 100,000	>1 in 10,000	1 in 10,000	No	No Further Action site.	No	Current residential risk of 3 in 10,000. ICs are required while radionuclides decay to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.
TSF-06, Area 10 Reactor Vessel Burial Site	Radionuclides	N/A	Not available	N/A	N/A	N/A	No	No Further Action site.	Yes	Contamination is assumed to be fixed to the site's buried reactor vessel. However, long-term ICs are required to prevent intrusion. In the event the U.S. Department of Energy mission should end at some future point, property transfer requirements, including issuance of a finding of suitability to transfer and control of land use, may be necessary.
TSF-06, Area 11 TSF-06 Ditch	Cesium-137 and cobalt-60	N/A	0.88–92 pCi/g	1 in 10,000	1 in 10,000	1 in 10,000	No	No Further Action site.	No	Current residential risk of 3 in 10,000. ICs are required while radionuclides decay to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.

Table 4-4. (continued).

Site Number	COCs	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 years	Basis for ICs and Comments
TSF-07 Disposal Pond	Cesium-137	N/A	0.0516- 135 pCi/g	1 in 1,000	1 in 10,000	8 in 10,000	N/A	No Further Action	Yes	ICs are required to protect occupational and future residential receptors until cesium-137 decays to acceptable levels for unrestricted land use.
	Arsenic	N/A	Mean = 12.8 mg/kg	No	No	No	1–14.7	No Further Action		Arsenic poses a risk to ecological receptors only.
	Mercury	N/A	Mean = 40.9 mg/kg	No	No	No	1,1–140.5	No Further Action		Mercury poses a risk to ecological receptors only.
	Tetrahydrofuran	N/A	Mean = 0.02 mg/kg	No	No	No	1.2–18,478	No Further Action		Tetrahydrofuran poses a risk to ecological receptors only.
	Thallium	N/A	Mean = 14.3 mg/kg	No	No	No	2.4–152	No Further Action		Thallium poses a risk to ecological receptors only.
TSF-08 Mercury Spill Area	Radionuclides Mercury	1.9[b]	0.4–73.7 mg/kg	8 in 1,000,000[c]	8 in 10,000,000[c]	1 in 10,000[c] hazard index = 30	1.1–289	Remediation to be performed under WAG 10 (OU 10-08)	To be determined	ICs are in place to restrict occupational access and residential development until the site is remediated.
TSF-09 and TSF-18 Soil around V-Tanks	Cesium-137[d]	23.3 pCi/g (future residential)	ND- 40,149 pCi/g	9 in 1,000	8 in 10,000	4 in 1,000	No	Remediation to be performed	No	ICs are required to protect occupational and future residential receptors. The need for continued ICs will be evaluated after remediation is complete.
TSF-10 Drainage Pond	Cesium-137	N/A	0.07–8.96 pCi/g	3 in 100,000	>1 in 10,000	1 in 10,000	No	No Further Action site	No	Current residential risk of 2 in 10,000. ICs are required while residual cesium-137 decays to levels appropriate for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.
TSF-26 Soil around PM-2A Tanks	Cesium-137[a]	23.3 pCi/g (future residential)	<23.3 pCi/g	Not available	Not available	1 in 1,000,000	No	Soil remediation complete	No	ICs will be required for <100 years or until discontinued in a 5-year review to allow residual cesium-137 contamination to decay to levels acceptable for unrestricted land use.
TSF-28 TSF Sewage Treatment Plant and Sludge Drying Beds	Radionuclides	N/A	Not available	Not available	Not available	Not available	No	No Further Action site[e]	No	ICs are required while residual radionuclides decay to levels appropriate for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.

Table 4-4. (continued).

Site Number	COCs	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 years	Basis for ICs and Comments
TSF-29 TSF Acid Pond	Cesium-137	N/A	0.9–16.1 pCi/g	1 in 10,000	>1 in 10,000	1 in 10,000	No	No Further Action site	No	Current residential risk of 3 in 10,000. ICs are required while residual cesium-137 decays to levels appropriate for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.
TSF-39 TSF Transite (Asbestos) Contamination	Asbestos	N/A	Small pieces of asbestos cement	Yes	Yes	Yes	No	No Further Action site	No	ICs are required to prevent intrusion.
TSF-42 TAN-607-A Room 161 Contaminated Pipe	Radionuclides	N/A	Fixed contamination inside pipe	Risk is unknown	Risk is unknown	Risk is unknown	No	No Further Action site[e]	No	Pipe internally contaminated with radioactive material is located under building TAN-607A. ICs are required to prevent intrusion.
TSF-43 Radioactive Parts Security Storage Area Buildings 647/648 and Pads	Radionuclides	N/A	Radioactive contamination under asphalt pads	Not available	Not available	Not available	No	No Further Action site.[e]	No[f]	ICs are required while residual radionuclides decay to levels appropriate for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews.
TSF-46	Cesium-137	23.3 pCi/g (future residential)	Not available	Not available	Not available	Not available	Not available	To be remediated	No	ICs are required to protect human receptors (occupational) from exposure until the site is remediated. Thereafter, ICs will be maintained until residual cesium-137 decays to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews. Contaminants are expected to be similar to those for the V-Tank soil and will be remediated concurrently.
TSF-47	Cesium-137	23.3 pCi/g (future residential)	Not available	Not available	Not available	Not available	Not available	To be remediated	No	ICs are required to protect human receptors (occupational) from exposure until the site is remediated. Thereafter, ICs will be maintained until residual cesium-137 decays to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews. Contaminants are expected to be similar to those for the V-Tank soil and will be remediated concurrently.

Table 4-4. (continued).

Site Number	COCs	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 years	Basis for ICs and Comments
TSF-48	Cesium-137	23.3 pCi/g (future residential)	Not available	Not available	Not available	Not available	Not available	To be remediated	No	ICs are required to protect human receptors (occupational) from exposure until the site is remediated. Thereafter, ICs will be maintained until residual cesium-137 decays to levels acceptable for unrestricted use. The need for continued ICs will be evaluated during 5-year reviews. Contaminants are expected to be similar to those for the V-Tank soil and will be remediated concurrently.
WRRTF-01 Water Reactor Research Test Facility Burn Pits II and IV	Asbestos	Asbestos at >1%, by volume, is a regulatory and health and safety concern	The post-ROD characterization measured asbestos levels in Pits II and IV above action levels	No	No	Yes	No	Remediation complete	Yes	ICs are necessary to maintain the native soil cover and prevent intrusion.
	Cadmium	N/A	Not available	No	No	No	2.6–4,000	Remediation complete		Cadmium poses risk to ecological receptors only.
IET-04	Radionuclides	N/A	Not available	N/A[g]	N/A[g]	N/A[g]	No[f]	No Further Action site[e]	Yes	Contamination is assumed to be fixed to the site's buried stack rubble. ICs are required to prevent intrusion.

Table 4-4. (continued).

Site Number	COCs	Final Remediation Goal and Basis	Residual Concentration (mg/kg or pCi/g)	Current Occupational Risk	Future Occupational Risk (30 years)	Future Residential Risk (100 years)	Ecological Risk (hazard quotient)	Remediation Status	ICs for >100 years	Basis for ICs and Comments

Sources of Information:

Comprehensive Remedial Investigation/Feasibility Study for the Test Area North Operable Unit 1-10 at the Idaho National Engineering and Environmental Laboratory (Blackmore et al. 1997)

OU 1-10 ROD (DOE-ID 1999a)

Institutional Control Plan for the Test Area North Waste Area Group 1 (INL 2000)

Group 2 Remedial Design/Remedial Action Work Plan Addendum for the Assessment and Cleanup of V-Tank Area New Sites, for the Test Area North, Waste Area Group 1, Operable Unit 1-10 (DOE-ID 2004e)

a. The 400-mg/kg final remediation goal for lead is based on EPA's residential screening level.

b. TSF-08 has been selected for a further treatability study under WAG 10.

c. COCs identified were for soils surrounding tanks only. The tanks contain radionuclides, heavy metals, polychlorinated biphenyls, and organic compounds.

d. Risk is not calculated for mercury because it is not a carcinogen. The excess cancer risk for the mercury spill area results from the presence of radionuclides.

e. Identification of the site as a No Action site was revised from the classification presented in the OU 1-10 proposed plan in accordance with *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities* (EPA 1999).

f. No pathway to ecological receptors.

g. Risk to human and ecological receptors was not calculated in the baseline risk assessment, as human and ecological receptors are not expected to be exposed to contamination because of the depth of cover and because radionuclides are fixed to the rubble. However, it is suspected that risk to human receptors may be >1 in 10,000.

Note: Site classification as a No Action site in the OU 1-07B ROD (DOE-ID 1995c) has been changed in accordance with *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities* (EPA 1999).

COC = contaminant of concern
EPA = U.S. Environmental Protection Agency
IC = institutional control
N/A = not applicable
OU = operable unit
ROD = record of decision
TSF = Technical Support Facility
WAG = waste area group

Table 4-5. Contaminant concentrations and risk levels for sites under institutional control at Test Area North groundwater.

Site Number	Contaminants of Concern	Final Remediation Goal and Basis (ppb or pCi/L)	Residual Concentration[a] (ppb or pCi/L)	Current Occupational Risk (100 years)	Future Residential Risk (100 years)[b]	Future Residential Risk (100 years)[c]	Pathway	Remediation Status	Institutional Controls for >100 Years
TSF-05 Injection Well	VOCs are:	Federal Drinking Water Standards	—	8 in 10,000,000 HI = 0.003	1 in 100,000 HI = 0.8	1 in 1,000 HI = 20.5	Ingestion of water containing VOCs	Remediation ongoing	No
				4 in 100,000,000 HI = N/A	7 in 10,000,000 HI = N/A	5 in 100,000 HI = N/A	Inhalation of VOCs		
				N/A	3 in 1,000,000 HI = 0.1	2 in 10,000 HI = 2.5	Ingestion of crops containing VOCs		
	Trichloroethene	5 ppb	12,000–32,000 ppb	N/A[d]	N/A[d]	N/A[d]			
	Tetrachloroethene	5 ppb	110 ppb	N/A[d]	N/A[d]	N/A[d]			
	Cis-1,2-DCE	70 ppb	3,200–7,500 ppb	N/A[d]	N/A[d]	N/A[d]			
	Trans-1,2-DCE	100 ppb	1,300–3,900 ppb	N/A[d]	N/A[d]	N/A[d]			
	Radionuclides are:	—	—	6 in 10,000,000 HI = N/A	4 in 1,000,000 HI = N/A	5 in 10,000 HI = N/A	Ingestion of water containing radionuclides	Remediation ongoing	No
				N/A	1 in 100,000 HI = 0.9	5 in 10,000 HI = 23	Ingestion of crops containing radionuclides		
	Tritium	20,000 pCi/L	14,900–15,300 pCi/L[c]	N/A[e]	N/A[e]	N/A[e]			
	Strontium-90	8 pCi/L	530–1,880 pCi/L	N/A[e]	N/A[e]	N/A[e]			
	Cesium-137	119 pCi/L[d]	1,600–2,150 pCi/L	N/A[e]	N/A[e]	N/A[e]			
	Uranium-234	30 pCi/L[d]	5.2–7.7 pCi/L[c]	N/A[e]	N/A[e]	N/A[e]			

Table 4-5. (continued).

Site Number	Contaminants of Concern	Final Remediation Goal and Basis (ppb or pCi/L)	Residual Concentration[a] (ppb or pCi/L)	Current Occupational Risk (100 years)	Future Residential Risk (100 years)[b]	Future Residential Risk (100 years)[c]	Pathway	Remediation Status	Institutional Controls for >100 Years
	Radionuclides and VOCs	—	—	1 in 1,000,000 HI = 0.003	3 in 100,000 HI = 0.9	2 in 1,000 HI = 23	Total risk (all pathways)	—	—

Sources of Information:

Remedial Investigation Final Report with Addenda for the Test Area North Groundwater Operable Unit 1-07B at the Idaho Nuclear Engineering and Environmental Laboratory (Kaminsky et al. 1994)

OU 1-07B ROD (DOE-ID 1995c)

a. The concentration range is taken from measured concentrations at the TSF-05 Injection Well

b. Case 1: Use of groundwater drawn from contaminant plume

c. Case 2: Use of groundwater drawn from injection well

d. Risk was calculated for all VOCs combined

e. Risk was calculated for all radionuclides combined.

DCE = dichloroethene
HI = hazard index
N/A = not applicable
VOC = volatile organic compound

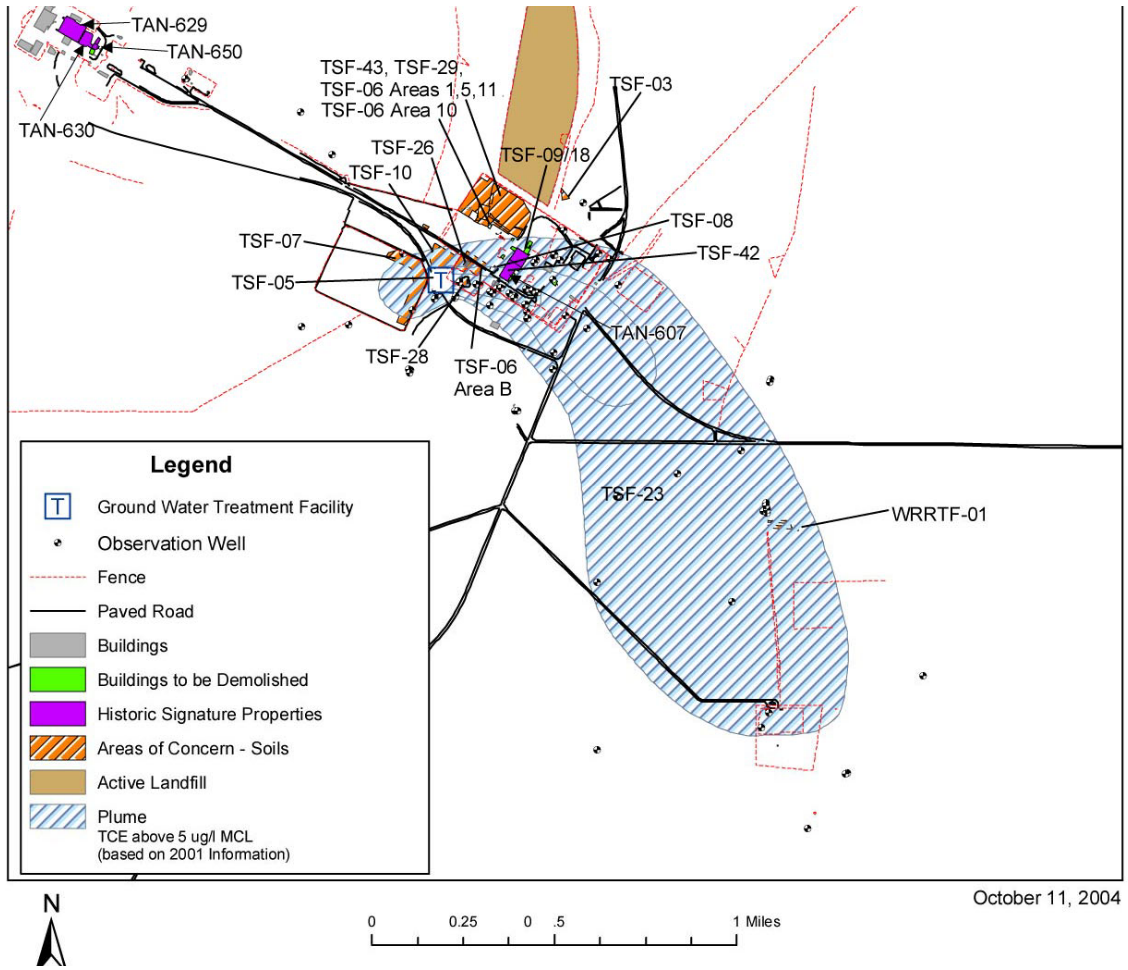


Figure 4-14. Test Area North map—current state.

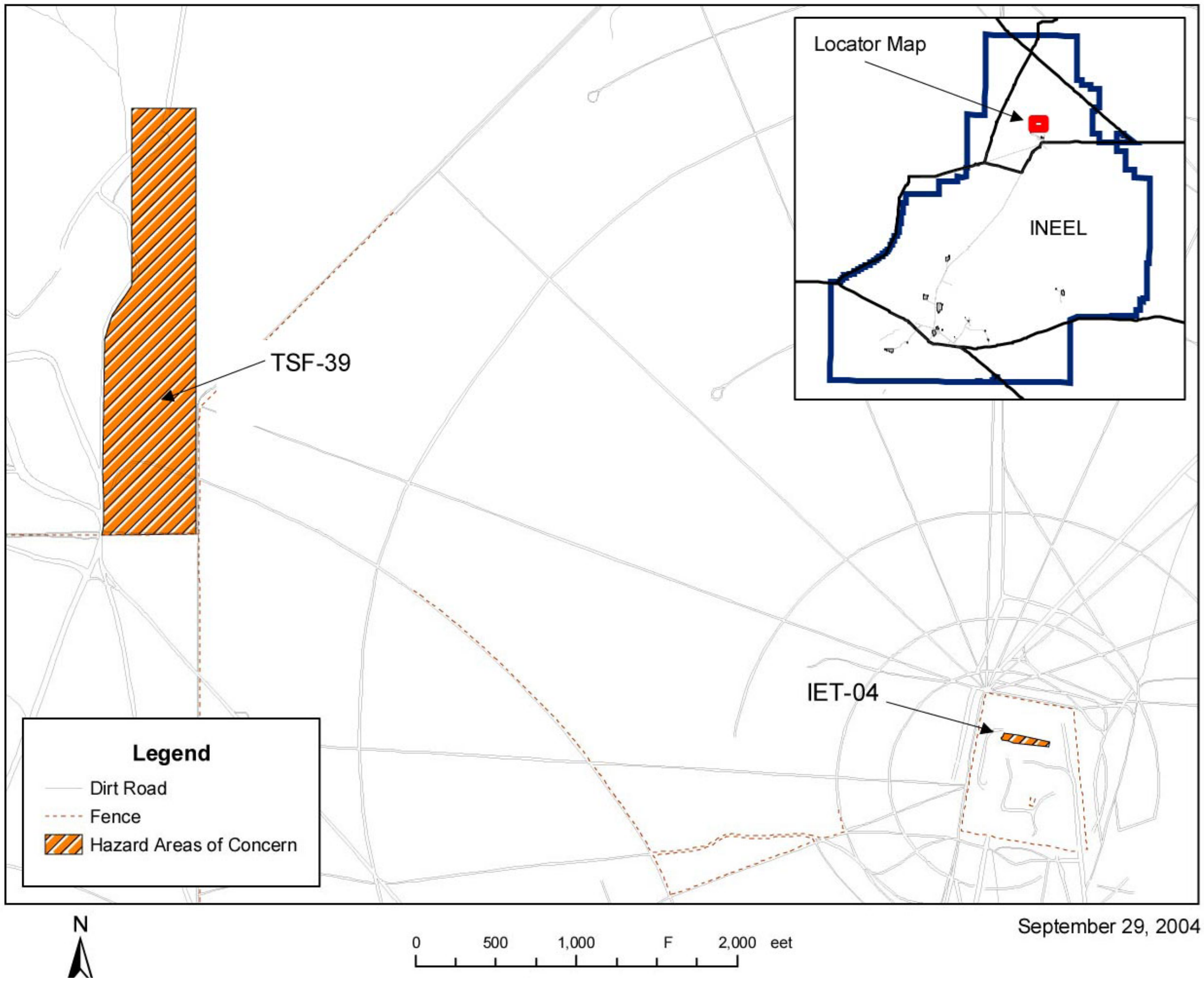
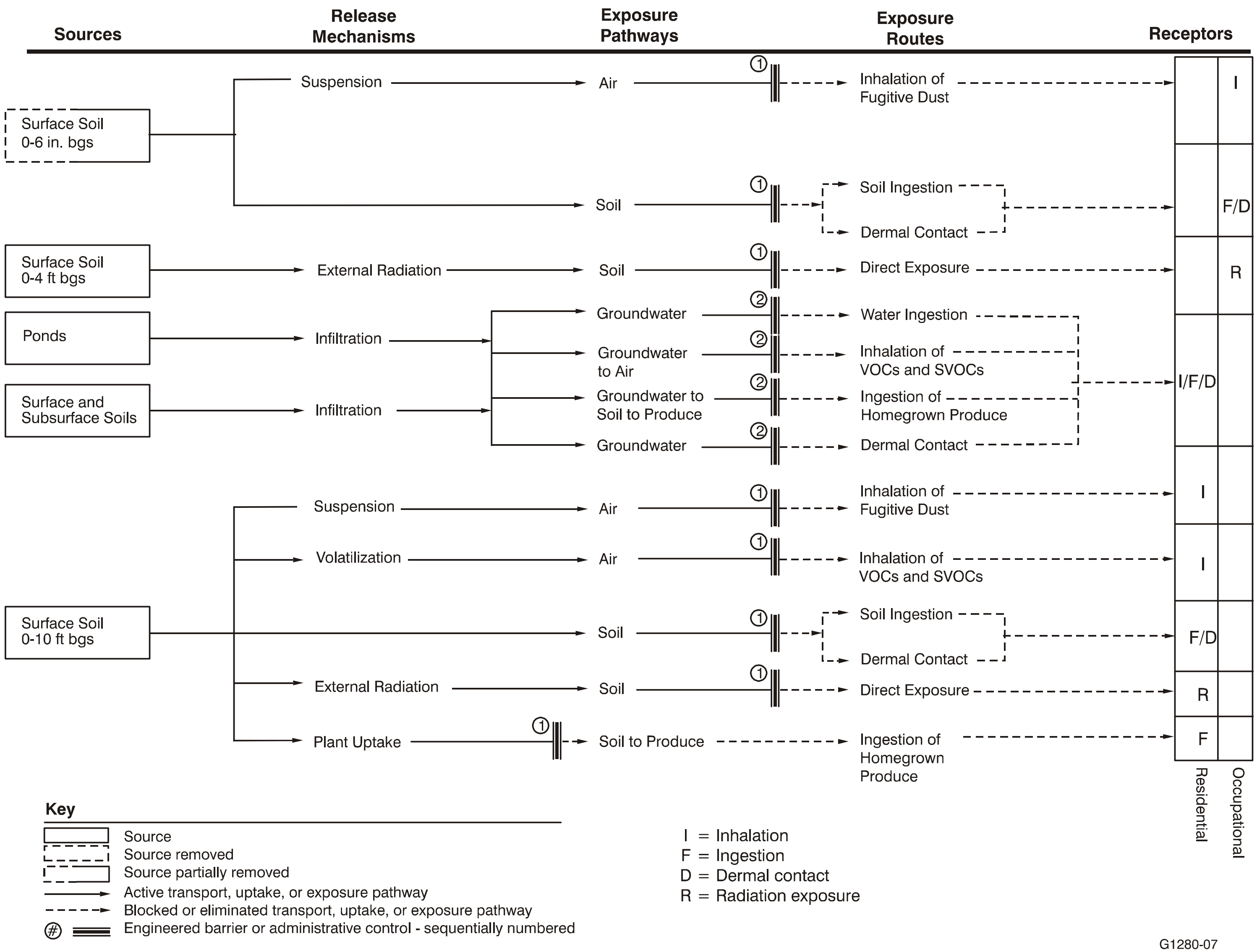


Figure 4-15. Test Area North facility detail map—current state.



SVOC = semivolatile organic compound

Figure 4-16. Test Area North conceptual site model—current state.

Narrative for Figure 4-16 Test Area North Conceptual Site Model—Current State

Remediation of all sites under the OU 1-10 ROD (DOE-ID 1999a) is planned to be completed in 2005, with the exception of potential contaminated soil under buildings or structures (i.e., collocated facilities).

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

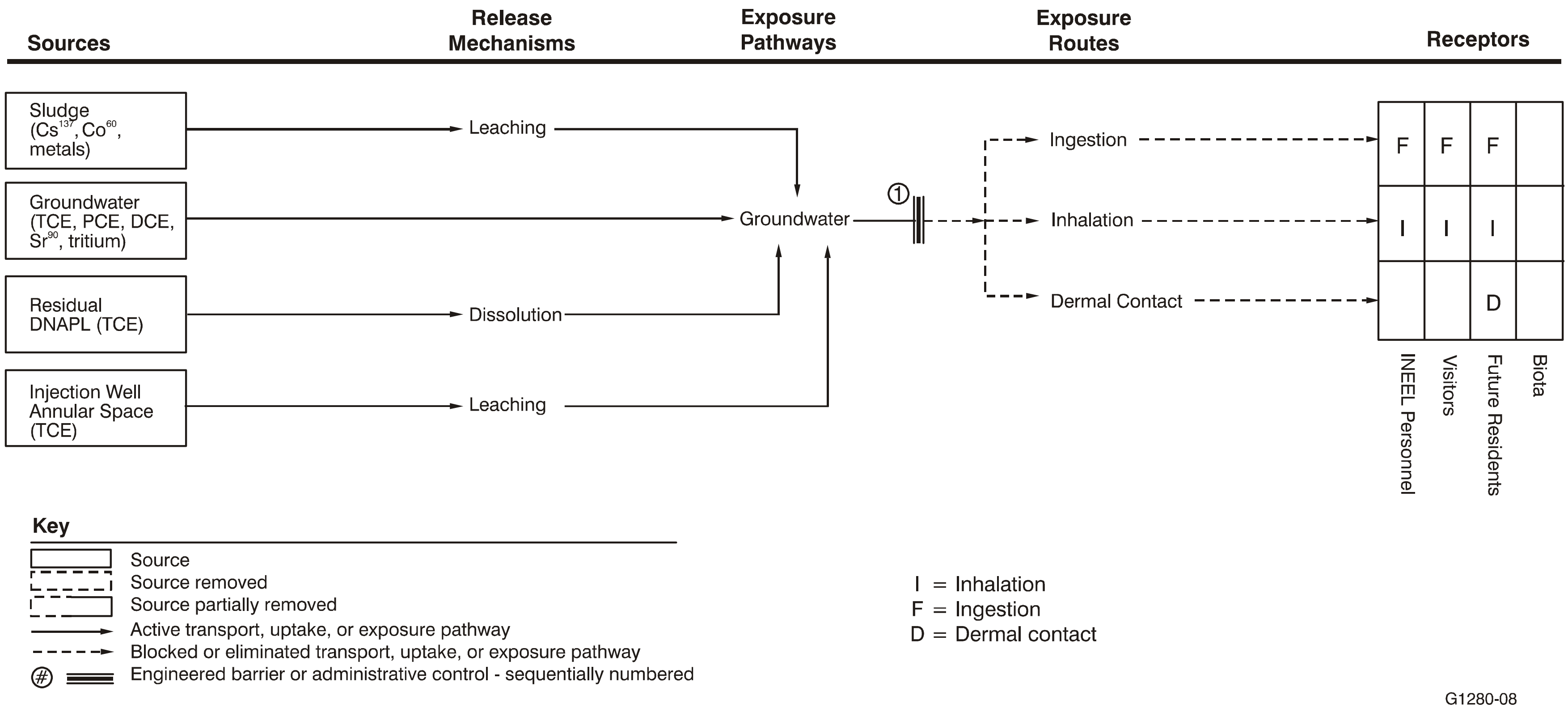
1. Sites that present an unacceptable risk to human health and the environment have institutional controls, and access is restricted. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities. The federal government will ensure that access and use restrictions are maintained and enforced until an acceptable risk level is attained.

2. The sites include the TSF-07 Disposal Pond, the TSF-10 Drainage Pond, and the TSF-29 Acid Pond. The TSF-07 Disposal Pond is an unlined disposal pond located southwest of TSF outside the facility fence. The TSF-07 Disposal Pond is currently in use and will undergo assessment when operations cease. The TSF-10 Drainage Pond is for surface water discharge. The TSF-10 Drainage Pond is a No Further Action site with institutional controls, because metals and low-level radionuclide contamination may be present. The TSF-29 Acid Pond is an unlined pond east of the Radioactive Parts Security Storage Area that received radioactive and treated wastewater from 1955 to 1958 in support of the Aircraft Nuclear Propulsion Program. In 1976, the TSF-29 Acid Pond was partially backfilled with soil containing radioactive particles from cleanup operations around TSF. It is also a No Further Action site with institutional controls. The sites are posted and have restricted access and use. An extensive groundwater monitoring program is in place, and contaminated water is not available to occupational or residential receptors. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through the work control process used to identify hazards and mitigation measures for planned work activities.

Failure Analysis:

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity inconsistent with the specific institutional controls for a site (e.g., unauthorized well drilling or intrusion into engineered covers) or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a) (e.g., change in land use from industrial to residential). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.



Cs^{137} = cesium-137
Co^{60} = cobalt-60
DCE = 1,2-dichloroethene
DNAPL = dense nonaqueous phase liquid
Sr^{90} = strontium-90

Figure 4-17. Test Area North groundwater conceptual site model—current state.

Narrative for Figure 4-17 Test Area North Groundwater Conceptual Site Model—Current State

To implement the in situ bioremediation process, sodium lactate is injected into the aquifer to stimulate naturally occurring microbes in the subsurface to digest and break down contaminants. Pump-and-treat technology is used to extract contaminated groundwater from the aquifer, treat it to remove hazardous constituents, and reinject clean water back into the aquifer. MNA takes advantage of naturally occurring bacteria to break down the hazardous waste chemical, TCE, into harmless end products.

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. In situ bioremediation in the hot spot, pump and treat in the medial zone, and MNA in the distal zone. Occupational access will be restricted until completion of the remediation is verified by postremediation sampling. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities.

   An extensive groundwater monitoring program is in place, and contaminated water is not available to occupational or residential receptors. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through the work control process used to identify hazards and mitigation measures for planned work activities.

Failure Analysis:

Because this amended remedy will result in COCs remaining onsite during the remedial action above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action and at least every 5 years thereafter through the standard CERCLA 5-year review process. The reviews will be conducted to ensure that the amended remedy is, or will be, protective of human health and the environment. This provision does not preclude more frequent reviews by one or more of the agencies. In the event that the selected remedial action is not protective of the environment or human health, a contingency remedy would then be required as indicated below.

In the distal zone, MNA will be used in place of the pump-and-treat remedy selected in the OU 1-07B ROD (DOE-ID 1995c). Natural attenuation acts without human intervention to reduce the toxicity, mobility, and volume of contaminants in the groundwater. Contaminant levels will be monitored to ensure an appropriate decay rate is being achieved. If, during periodic reviews conducted at least every 5 years, MNA is determined to be inadequate for restoration of the distal zone by 2095, then a contingency remedy for the distal zone will be implemented. The contingency remedy also will be invoked if the required monitoring necessary for MNA is not performed. The contingency remedy for the distal zone is the default remedy selected in the OU 1-07B ROD (DOE-ID 1995c): groundwater extraction, aboveground treatment of VOCs, and reinjection of the treated water or, if the agencies concur, implementation of a more cost-effective remedy identified at the time the contingency remedy is implemented.

In the event that the radionuclide COCs (cesium-137, strontium-90, tritium, and uranium-234) in the medial zone portion of the plume exceed established limits, that portion of the plume would be intercepted. After treatment to remove VOCs (as was done during the in situ bioremediation treatability studies conducted to support the ROD amendment), the treated water would be reinjected upgradient from the extraction well to facilitate sorption of radionuclides onto subsurface soil and rock.

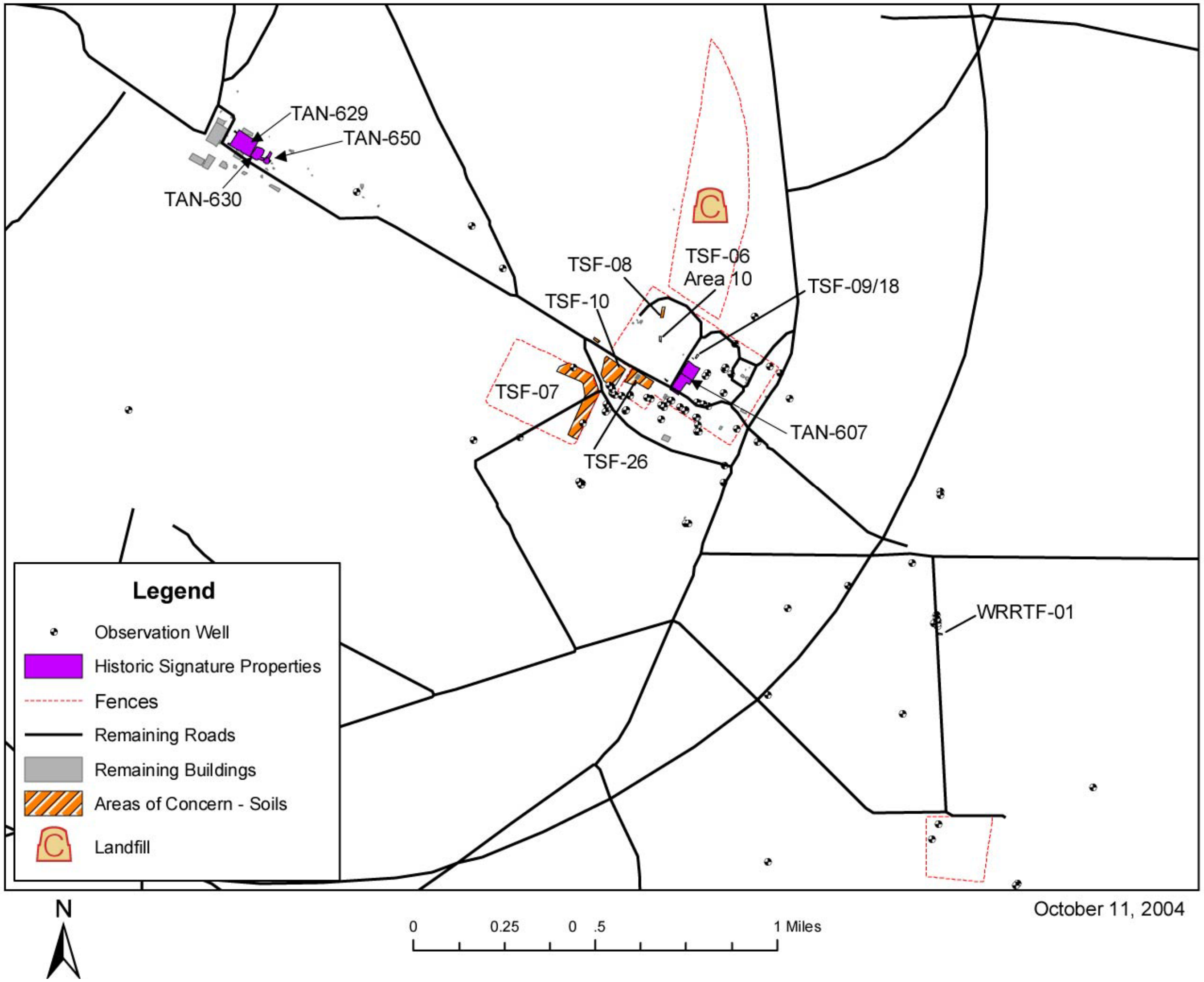


Figure 4-18. Test Area North map—end state.

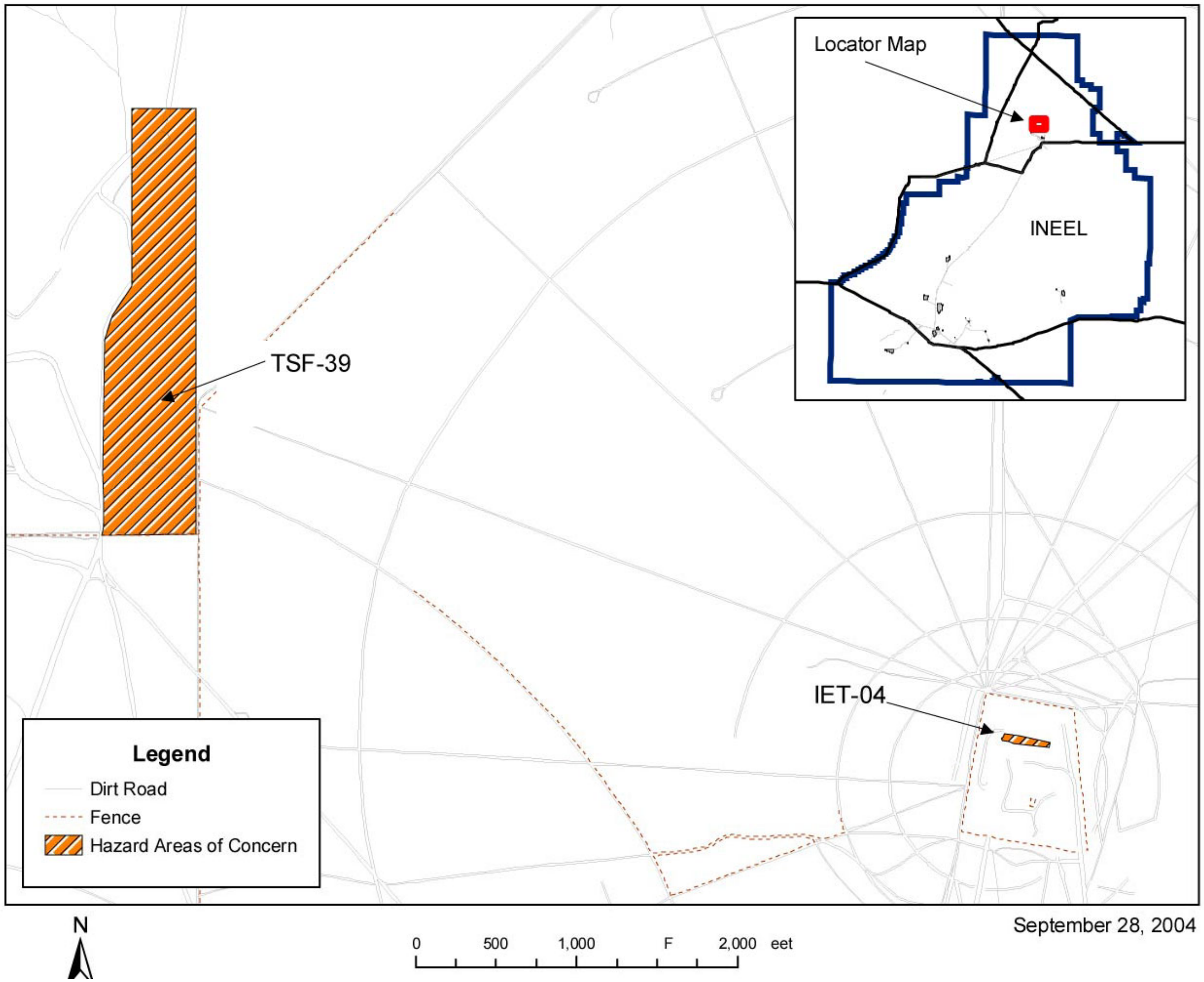
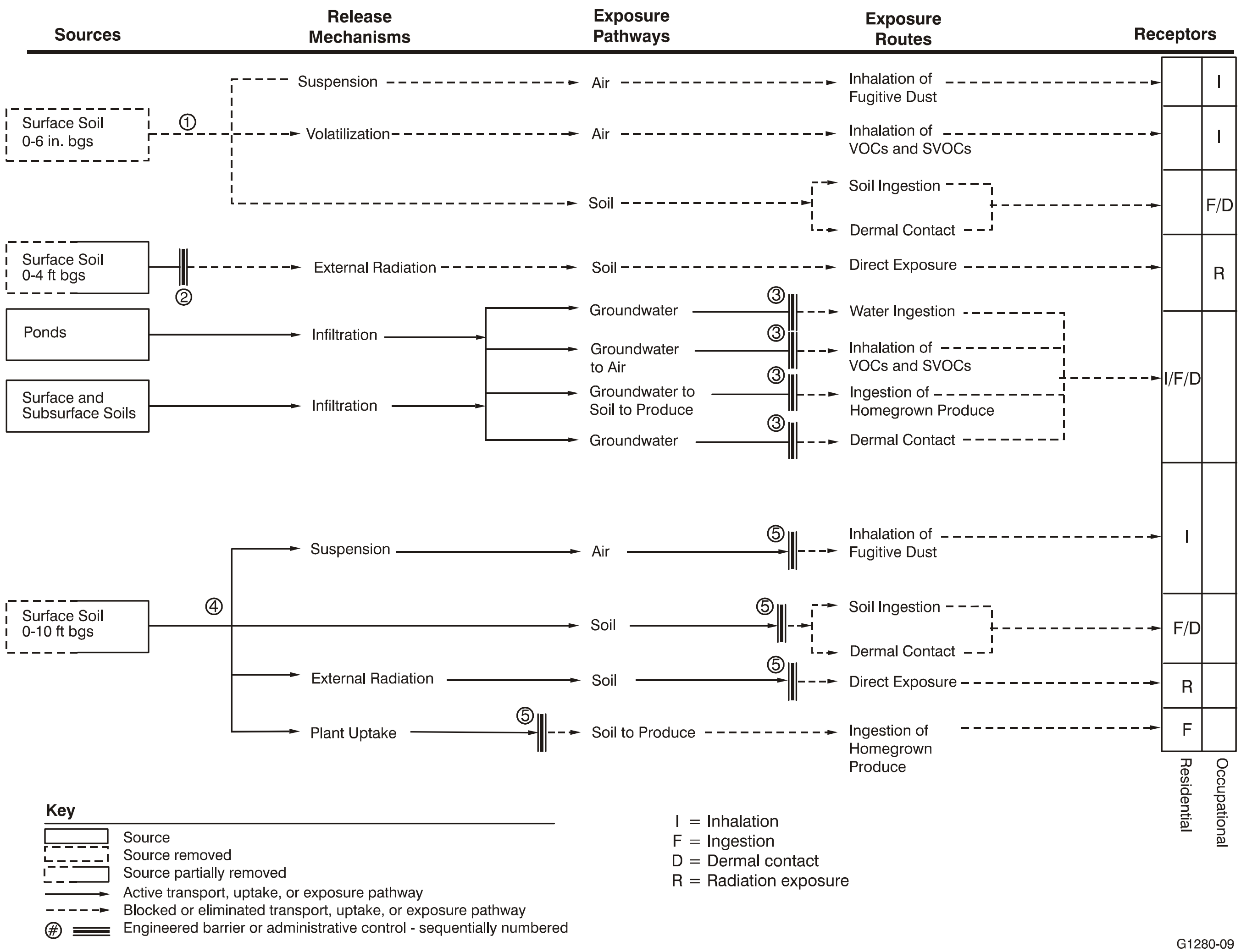


Figure 4-19. Test Area North facility detail map—end state.



SVOC = semivolatile organic compound

Figure 4-20. Test Area North conceptual site model—end state.

Narrative for Figure 4-20 Test Area North Conceptual Site Model—End State

Remediation of all sites under the OU 1-10 ROD (DOE-ID 1999a) is planned to be completed by 2005, with the exception of potential contaminated soil under buildings or structures (i.e., collocated facilities). IET-04, TSF-06 Area 10, the TSF-07 Disposal Pond, the TSF-09 and TSF-18 V-Tanks soil, the TSF-26 PM-2A Tanks soil area, the WRRTF-01 Burn Pits, the TSF-08 Mercury Spill Area, the TSF-10 Drainage Pond, and the TSF-39 Transite Contamination Area may remain under institutional control beyond 2035 depending on results of the 5-year remedy effectiveness reviews.

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. For the Surface Soil (0–6 in. below ground) contamination area, the selected remedy is excavation and disposal. This will include excavation of the contaminated soil; disposal at the ICDF; and backfill, contour, and revegetation of the area. The source of contamination will be removed breaking the pathway by which a future receptor may be exposed.

2. For the Surface Soil (0–4 ft below ground) contamination areas (e.g., TSF-06, Areas 5, 7, 9, and 11 and Area B), the OU 1-10 ROD (DOE-ID 1999a) selected remedy is excavation and disposal. This will include excavation of the contaminated soil; disposal at the ICDF; and backfill, contour, and revegetation of the area. The source of contamination will be removed breaking the pathway by which a future receptor may be exposed. The OU 1-10 ROD (DOE-ID 1999a) selected remedy for some Surface Soil (0–4 ft below ground) contamination areas (e.g., TSF-29) was No Further Action with institutional controls. These sites are posted and restrict occupational access and use.

3. Pond sites include the TSF-07 Disposal Pond, the TSF-10 Drainage Pond, and the TSF-29 Acid Pond. The OU 1-10 ROD (DOE-ID 1999a) selected remedy for these sites was Limited Action or No Further Action with institutional controls, since cesium-137 will decay to less than unrestricted land-use concentrations within 100 years. The sites are posted and have restricted access and use. An extensive groundwater monitoring program is in place, and contaminated water is not available to occupational or residential receptors. The entire INL Site has restricted access to prevent intrusion by the public. Workers are protected through the work control process used to identify hazards and mitigation measures for planned work activities.

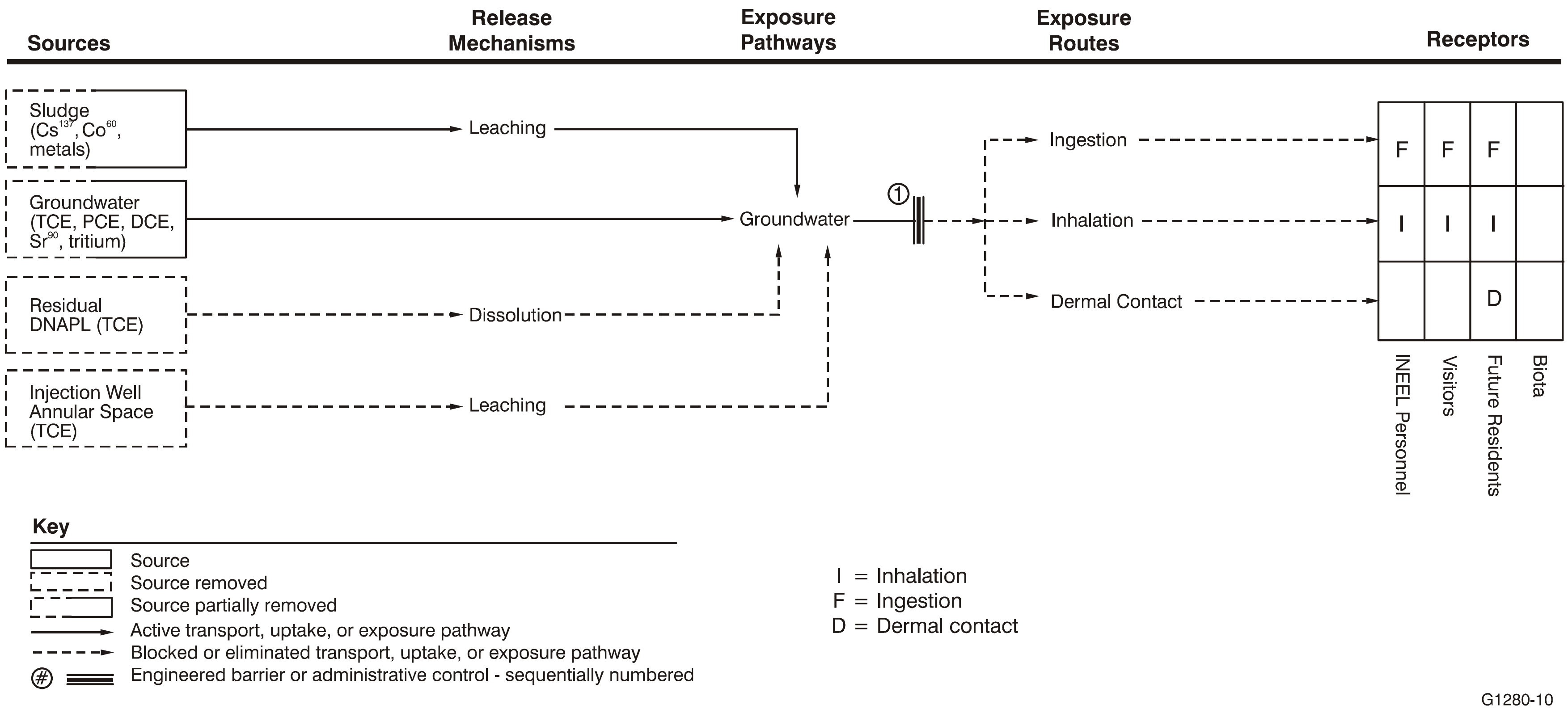
4. For the Surface Soil (0–10 ft below ground) contamination areas, the selected remedy is excavation and disposal. This will include excavation of the contaminated soil; disposal at the ICDF; and backfill, contour, and revegetation of the area. The source of contamination will be removed breaking the pathway by which a future receptor may be exposed. The Surface Soil (0–10 ft below ground) site that may require institutional controls beyond 2035 is the TSF Mercury Spill Area, where it was reported that mercury leaked onto the ground and railroad system. This site was selected for a potential phytoremediation treatability study under WAG 10. In the *Explanation of Significant Differences for the Record of Decision for the Test Area North Operable Unit 1-10* (DOE-ID 2003b), the remedy for WRRTF-01 Pits II and IV has been changed to native soil cover, and the COC is asbestos.

5. Institutional controls will be required to prevent risk to human receptors beyond 2035. As long as there is an active DOE mission at the INL, public access to the site will continue to be restricted, and workers will be protected through work control procedures and posting of signs at contaminated sites. In the event that the DOE mission should end at some unknown time in the future, deed restrictions would be required to prevent intrusion into those areas with residual contamination.

Failure Analysis:

Although failed controls are most likely to be found during the annual assessments, they may be discovered at any time. Subcontractors identifying a failed control will notify DOE Idaho. DOE Idaho will notify the EPA and DEQ within 2 business days after discovery of any major activity inconsistent with the specific institutional controls for a site (e.g., unauthorized well drilling or intrusion into engineered covers) or of any change in the land use or land-use designation of a site addressed in the ROD and listed in the INL CFLUP (DOE-ID 1997a) (e.g., change in land use from industrial to residential). Minor inconsistencies (e.g., signs down or missing) will be resolved as necessary. If minor inconsistencies are identified during the annual assessment, the issue and resolution will be documented in the reports.

If DOE Idaho believes that an emergency exists, DOE Idaho can respond to the emergency immediately before notifying EPA and DEQ and need not wait for any EPA or DEQ input to determine a plan of action. DOE Idaho will identify the root cause of the institutional control process failure, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and DEQ. Table A-1 (see Appendix A) provides responses to failed control procedures that will be used during DOE Idaho control of the INL Site.



Cs^{137} = cesium-137
Co^{60} = cobalt-60
DCE = 1,2-dichloroethene
DNAPL = dense nonaqueous phase liquid
Sr^{90} = strontium-90

Figure 4-21. Test Area North groundwater conceptual site model—end state.

Narrative for Figure 4-21 Test Area North Groundwater Conceptual Site Model—End State

By 2035, the in situ bioremediation and pump-and-treat portions of the remedial action will be complete, and MNA will be ongoing. Institutional controls will be maintained until the entire plume reaches the remedial action objectives identified in the Fiscal Year 2001 *Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action, Operable Unit 1-07B* (DOE-ID 2001b). The timeframe identified for all remediation activities to be complete and for the plume to meet remedial action objectives is 2095.

Actions and Barriers:

The steps taken to mitigate or remove these hazards are as follows:

1. Monitoring and maintenance of institutional controls will continue until the entire plume reaches the remedial action objectives. Occupational access will be restricted until completion of the remediation is verified by postremediation sampling. The entire INL Site has restricted access and use to prevent intrusion by the public. Workers are protected through posting of signs at contaminated sites, by recording contaminated sites in the Site institutional controls database, and through the work control process used to identify hazards and mitigation measures for planned work activities.

Failure Analysis:

Because this amended remedy will result in COCs remaining onsite during the remedial action above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action and at least every 5 years thereafter through the standard CERCLA 5-year review process. The reviews will be conducted to ensure that the amended remedy is, or will be, protective of human health and the environment. This provision does not preclude more frequent reviews by one or more of the agencies. In the event that the selected remedial action is not protective of the environment or human health, a contingency remedy would then be required as indicated below.

In the distal zone, MNA will be used in place of the pump-and-treat remedy selected in the OU 1-07B ROD (DOE-ID 1995c). Natural attenuation acts without human intervention to reduce the toxicity, mobility, and volume of contaminants in the groundwater. Contaminant levels will be monitored to ensure an appropriate decay rate is being achieved. If, during periodic reviews conducted at least every 5 years, MNA is determined to be inadequate for restoration of the distal zone by 2095, then a contingency remedy for the distal zone will be implemented. The contingency remedy also will be invoked if the required monitoring necessary for MNA is not performed. The contingency remedy for the distal zone is the default remedy selected in the 1995 ROD: groundwater extraction, aboveground treatment of VOCs, and reinjection of the treated water or, if the agencies concur, implementation of a more cost-effective remedy identified at the time the contingency remedy is implemented.

In the event that the radionuclide COCs (cesium-137, strontium-90, tritium, and uranium-234) in the medial zone portion of the plume exceed established limits, that portion of the plume would be intercepted upgradient of the Nuclear Proof Test Facility. After treatment to remove VOCs (as was done during the in situ bioremediation treatability studies conducted to support the ROD amendment), the treated water would be reinjected upgradient from the extraction well to facilitate sorption of radionuclides onto subsurface soil and rock.